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Digital readiness and financial performance in the financial industry: evidence from emerging market economies

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Digital Readiness and Financial Performance in the Financial Industry: Evidence from Emerging Market Economies

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Sculpting global leaders

A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business.

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ABSTRACT

This study examines the impact of digital readiness on financial performance of listed firms in Brazil, Russia, India, China and South Africa. It is based on 1 224 firms across BRICS where 135, 41, 711 and 337 firms represent banks, insurance, investments and real estate industries, respectively. The Arbitrage Pricing Theory was extended by including the digital readiness component from the Network Readiness Index Framework. Generalized Method of Moments regression was used as the main data analysis model. Key findings are as follows:

[1] The extended Arbitrage Pricing Theory and the longitudinal research design approach was found to be ideal for the study as supported by model statistics. **[2]** The current state of enabling infrastructure is not a key determinant of financial performance. **[3]** Internet affordability effects generally have a positive and significant impact on financial performance of banking and insurance firms. **[4]** Skills and education have positive and significant impact on financial performance of banking and insurance firms. **[5]** Financial performance in investments and real estate firms generally respond negatively to variations in digital readiness. **[6]** Market-based financial performance measures respond better to variations in digital readiness when compared to accounting-based measures of financial performance.

Keywords: Financial performance, Digital Readiness, Causality, Generalised Method of Moments, Brazil, Russia, India, China, South Africa

DECLARATION

I, Chiedza Ndlovu, student number 333081, hereby declare that this Masters thesis is my own work except where indicated in the references and acknowledgements. The research was conducted at Wits Business School (WBS) under the supervision of Professor Leona Craffert. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in Digital Business at the University of the Witwatersrand, Johannesburg. This work is not a reproduction in part or in whole of any research presented for the award of a degree.

Chiedza Ndlovu,



Parktown, Johannesburg (South Africa)

Signed on Friday, 31 July 2021

DEDICATION

TO GOD THE ALPHA AND THE OMEGA, GLORY TO THE HIGHEST POWER.

TO MY PARENTS, SIBLINGS, MY WIFE AND MY CHILDREN.

ACKNOWLEDGEMENT

I give my humble and sincerest appreciation to God, for guiding me throughout my entire schooling journey since 1996. I humbly express my heart felt gratitude to my supervisor, Professor Leona Craffert for her invaluable support to this research work. I managed to complete my research under her expert guidance and supervision which I do not take for granted. To my colleagues and classmates, Qoqanani Mkhwananzi and Qubani Nkala all supported me in different ways and thus deserve special mention here.

I would like to extend my gratitude to my father, Bomba Ndlovu, and mother, Priscillar Ndlovu, for invaluable life lessons and support throughout my various endeavours. All my brothers and sisters, thank you for being a family. Be blessed by God in your various endeavours.

Special thanks go to my lovely wife Fortunate Ndlovu and sons Prince Tjedza Junior Ndlovu and Chris Tshedza Jnr Ndlovu, who all bring great and immensurable joy in my life every day. My wife and sons sacrificed their quality time so I could focus on my studies. Their support and sacrifices cannot be taken for granted, as such, I am indebted to them. I could not list everyone in this acknowledgement, for those I may have left out, you all gave me valuable assistance and support in different ways, I thank you all.

The usual caveats apply.

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LIST OF ACRONYMS

AIC - Akaike Information Criterion

4IR – Fourth Industrial Revolution

BRICS – Brazil, Russia, India, China, South Africa

DR – Digital Readiness

ER – Equity Returns

GMM – Generalised Method of Moments

NRI - Network Readiness Index

ROE – Return on Equity

USD – United States Dollar

WEF – World Economic Forum

CHAPTER 1. INTRODUCTION

The purpose, context and problem statement of the study lays the foundation of this research followed by the objectives and significance of the study. Delimitations, definitions, assumptions and the outline of the study are presented last.

1.1 PURPOSE OF THE STUDY

The Fourth Industrial Revolution (hereon referred to as 4IR) is here to stay and its impact is already being felt across the globe. 4IR is a new era that builds and extends the impact of digitization in new and unanticipated ways (World Economic Forum, 2016b). As a result, financial institutions have started to see a significant drop in in-person-based transactions in favour of digital-based transactions (Gomber, Kauffman, Parker and Weber, 2018).

In banking for example, the role of branches is slowly but surely changing from transactional to advisory and banks are resizing and repositioning themselves to adapt to these changes (Citi, 2016). These and similar changes come with unclear realities on financial performance of incumbent financial firms, specifically the impact on equity returns and Return on Equity (ROE). According to Seth (2020), equity returns as measured by market capitalisation represents the market value of a listed entity and ROE is a profitability measure based on shareholders' invested capital (Firer, Ross, Westerfield and Jordan, 2012).

The purpose of this study is to conduct a comparative analysis of the effect of digital readiness on the equity returns and ROE of listed financial firms in Brazil, Russia, India, China and South Africa (BRICS). Previous research fell short in employing comparative analysis in various sections of the financial industry as well as a failure to account for heterogenous country specific effects (Ndlovu and Alagidede, 2018).

The limited and inconclusive comparative analysis on market-based vis-a-vis accounting-based measures of financial performance has left interested parties

with an incomplete view on the drivers of financial performance in financial firms. Furthermore, this remarkable gap leaves a potentially huge void of pertinent information as well as significant deprivation of valuable insights to all stakeholders in the financial industry, specifically on how financial performance is impacted by digital readiness of a country.

Below is an illustration of the Digital Readiness Conceptual Framework of the study:

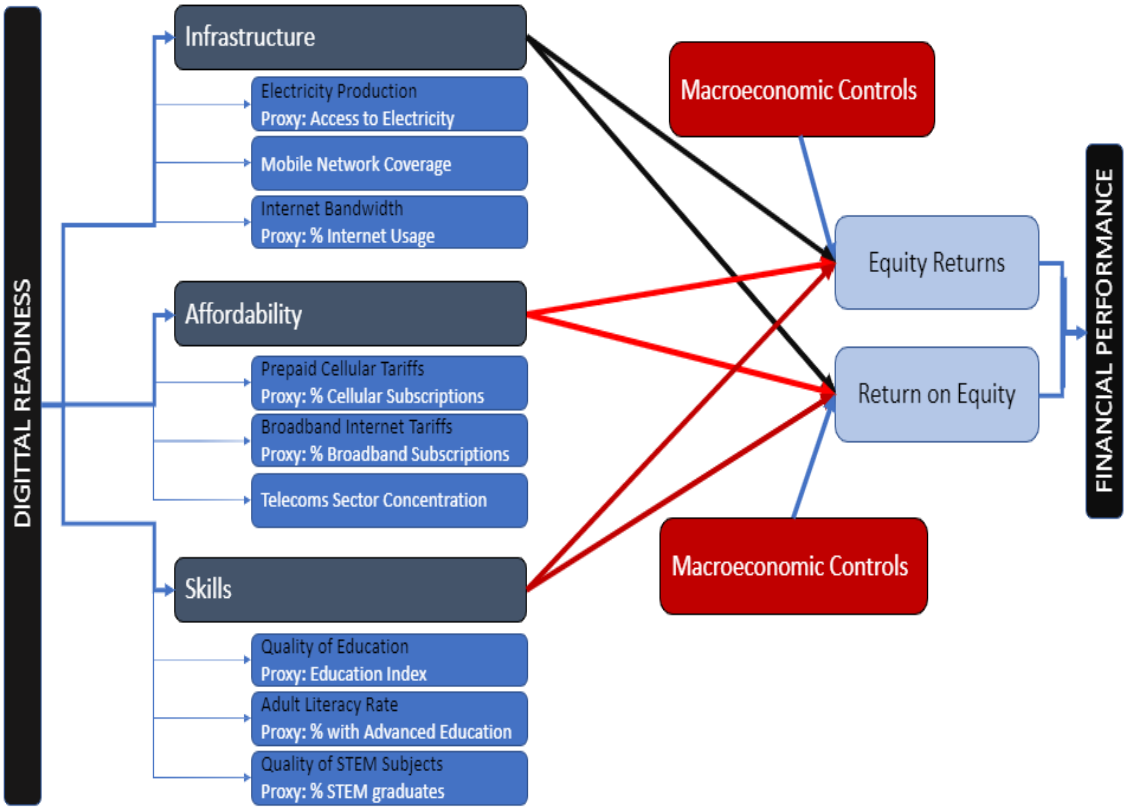


Figure 1: Digital Readiness Conceptual Framework

Source: Adapted from Baller, Dutta and Lanvin (2016)

The above digital readiness conceptual framework is adapted from the World Economic Forum (WEF) Network Readiness Index (NRI) framework which was first developed by Kirkman, Osorio and Sachs (2002) to measure a nation's preparedness for the networked world. These authors found very little in the literature to guide their conviction on how digital readiness could possibly drive economic outcomes. Subsequently, Baller, Dutta and Lanvin (2016) made an attempt to link digital diffusion and economic impact.

This is one of the motivations why this study partially adopts their 2016 NRI framework, specifically borrowing on infrastructure, affordability and skills indicators. As supported by Cann (2016), infrastructure is a key determinant of digital readiness alongside affordability and skills. In addition, this study acknowledges the fact that financial perfomance could also be impacted by other external factors such as macroeconomic indicators (see Patro, Wald and Wu, 2002; Ward and Price, 2006; Ndlovu and Alagidede, 2018), hence the inclusion of macroeconomic variables as controls for externalities in order to have a clear view of the impact of digital readiness.

1.2 CONTEXT OF THE STUDY

The growth of Financial Technology (FinTechs) firms could potentially be a threat to financial returns in the financial industry (Citi, 2016; Accenture, 2016). Financial Stability Board (2020) defines FinTech as a technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services. Kagan (2020) defined FinTechs as firms that seeks to improve and automate the delivery and use of financial services using technology and data. Ketterer, Himmelreich and Schmid (2016) has recently observed that these FinTech firms are increasingly attacking banks' and insurers' core businesses and reshaping these industries. For example, payment facilitation by banks is now being democratised and made available to many users through FinTech platforms, thus taking away some of the banking revenue streams and its competitive advantage.

Compared to the previous revolutions, the 4IR acceleration is very fast and complex (Lee and Trimi, 2020), which leaves questions hanging as to whether accounting measures of financial performance such as ROE fully capture the effects of digital changes or these changes are better reflected in responsive market-based measures of financial performance? Secondly, market capitalisation is a good proxy to measure industry growth and equity returns. Using this proxy is important in estimating the immediate impact of digital

changes because anecdotal evidence show that FinTech disruption will initially eat industry growth by taking new segments and products before ultimately turning on traditional revenues (Citi, 2016). Thus, this study will illuminate our understanding on whether the financial industry growth has already started to be impacted by FinTechs whose business models respond quicker to improvements in digital readiness.

Most recently, the COVID-19 global pandemic has proven that digital infrastructure readiness is crucially important to support business continuity especially for service-oriented industries such as the financial services sector. One would then infer that if digital infrastructure readiness is that important for the continuity of businesses then financial performance could equally be impacted. A deeper contextual understanding on how digital readiness indicators impact financial performance of financial firms of emerging economies is important because emerging markets stand to benefit from recent digital innovations (Atkinson and McKay, 2007). Amongst BRICS, China is the leader in digital developments (see Appendix B), thus, lessons learnt could be transferred to other emerging countries in order to fast track the benefits realized and proactively mitigate any unintended consequences of 4IR without overly stifling innovative and entrepreneurial aspirations.

Various authors have investigated the impact of digital readiness on various sectors such as in government (Sánchez and Zuntini, 2019), in manufacturing (De Carolis, Macchi, Negri and Terzi, 2017), in financial services (Ali, 2018; Accenture, 2016), in education (Quaicoe and Pata, 2015), in journalism (Hamzah and Mustafa, 2014), just to name a few, however, none of the authors conducted a country and industry comparative analysis on digital readiness and its impact on financial performance.

Therefore, this study is not trivial because firstly it evaluates the impact of digital readiness on financial returns across five of the most developed economies in emerging markets. Secondly, the study distils digital readiness into constituent parts of infrastructure readiness, internet affordability and skills levels. Thirdly, the financial industry is divided into banking, insurance, investment and real

estate companies in order to eliminate the noise that often comes with aggregated studies at a holistic country-financial sector level.

It is hoped that this unique comparative analysis will contribute to emerging debates on digital readiness and its impact as well as making conclusions on whether the new players (FinTechs) in the financial industry have already started disrupting equity returns and profitability prospects of incumbent firms.

Authors such as Armstrong (2020) found a questionable correlation between digital readiness and economic growth, which demonstrates that the general impact of digital changes across sectors is least understood (see Appendix C). Understanding the association between digital readiness and financial performance in the financial industry will provide much needed guidance to regulators on how fast the financial industry is being disrupted and then respond quickly with fit-for-purpose regulatory frameworks.

In fact, since China and India are regarded as having the most mature FinTech industries amongst the BRICS countries, Brazil, Russia, South Africa and other developing nations could reap early benefits from Chinese and Indian lessons and therefore accelerate digital outcomes such as financial inclusion and reduce or possibly avoid the widening gap in digital divide as well as unfair industry competition that may potentially incubate as a result of an imbalance in digital diffusion.

1.3 RESEARCH PROBLEM

This research cross-examines four themes in investigating the effect of digital readiness on financial performance of listed financial firms in BRICS countries. These important aspects of the investigation are: (i) the effects of infrastructure readiness on financial performance of financial companies (ii) the effects of internet affordability on financial performance of financial companies, (iii) the effects of skill levels on financial performance of financial companies, and (iv) whether market-based measures of financial performance respond different to

digital readiness when compared to accounting-based measures of financial performance.

1.3.1 Infrastructure readiness and financial performance dynamics

The study on the determinants of financial performance in the financial industry cannot be regarded as comprehensive when little is known about the role of digital readiness as a potential determinant of financial performance. This is becoming more important than ever given the exponential spread of the 4IR effects into the global economy. Yermack (2018) found that the penetration of electrical grid in some countries has resulted in higher adoption of financial technology, but little has been documented on the impact of electricity infrastructure on financial performance in financial firms. On the contrary, Blimpo, McRae and Steinbuks (2018) argue that low electrification rates in African countries is a by-product of low tariff rates that discourage utilities from making capital investments that could improve the penetration of electrical grid.

In line to the WEF NRI framework calculations, infrastructure readiness is calculated as the sum average of the percentage of the population with access to electricity as a proxy for electricity production, mobile network coverage and percentage of internet usage as a proxy for internet bandwidth. Proxies were used due to a lack of complete and reliable data on electricity production and internet bandwidth across BRICS countries over the 10-year period under study.

1.3.2 Internet affordability and financial performance dynamics

Scanty research efforts have gone into understanding the impact of internet affordability on financial performance of financial firms. In fact, Lambrechts and Sinha (2019) argue that internet affordability is not given enough attention in emerging markets because the countries prioritise most burning issues such as famine, corruption, education and unemployment. One would wonder why this is the case because greater internet and mobile phone network penetration has been found to result in higher levels of financial inclusion (Yermack, 2018).

It is tempting to assume and conclude that affordability of the internet should logically translate to a positive impact in the financial industry's financial performance, however, this could be a fallacy until it is empirically proven. This is because authors such as Ali (2018) found a negative correlation between financial performance and the proliferation of digital banking. On the other hand (Citi, 2016) argue that the acceleration of smartphones and rising broadband connectivity is making the ecosystem more favourable to digital disruption, and questions remain unanswered as to the extent of financial performance disruption in the financial industry because of digital readiness.

In line to the WEF NRI framework calculations, internet affordability is calculated at the sum average of percentage of prepaid cellular subscriptions as a proxy for prepaid cellular tariffs, broadband subscriptions as a proxy for broadband internet tariffs and telecommunications industry concentration. Proxies were used due to a lack of complete and reliable data on prepaid cellular tariffs and broadband internet tariffs across BRICS countries over the 10-year period under study.

1.3.3 Skill levels and financial performance dynamics

Since the financial industry is predominantly a service driven industry, it has become increasingly vulnerable to skill levels and how the newly created knowledge impacts business value and models, and ultimately financial performance. Previously, it has been empirically proven that indeed there is a strong positive correlation between worker productivity and firm profitability (Citi, 2016), however, little is documented on how skills impact financial performance in BRICS financial firms.

In line to the WEF NRI framework calculations, skill level index is calculated as the sum average of the percentage of education index as a proxy for quality of education, percentage of population with advanced education as a proxy for adult literacy rates and percentage of Science, Technology, Engineering and Mathematics (STEM) graduates as a proxy for quality of STEM subjects. Proxies were used due to a lack of complete and reliable data on quality of education,

adult literacy rates and quality of STEM subjects across BRICS countries over the 10-year period under study.

1.3.4 Disparities of market-based vis-à-vis accounting-based measures

This study postulates that accounting-based measures of financial performance could lag the speed of digital changes, thus, market-based measures of financial performance could capture the changes in the digital landscape as soon as they occur. This supposition is tested by adopting existing theories on equity returns such as the Arbitrage Pricing Theory (APT) which was developed by Ross (1976) and acknowledging that innovation theories (see Hansen, Lüdeke-Freund, Quan and West, 2018; Singla, Ahujaa and Sethi, 2018) may as well explain variations in equity returns.

In particular, efforts that seek to rapidly improve infrastructure readiness, affordability of internet and skill levels are some of the digital developments that are hypothesised to impact market financial performance measures quicker than accounting-based financial performance measures. This view is in line with the observations made by Tayeh, Al-Jarrah and Tarhini (2015) and Conyon and He (2014) who argue that market-based measures of financial performance are generally preferred over accounting-based measures of financial performance because market-based measures not only capture busines performance but can also provide insights on business strategy and its future business performance outlook.

1.4 RESEARCH OBJECTIVES

The main objective of this research is to ascertain whether digital readiness has an impact on the financial performance of financial firms in BRICS countries. In addition, the study shall compare whether there are notable differences between countries and across industries. The key focus is centred on the effects of infrastructure readiness, internet affordability and skill levels. Considering the

problem statement presented in section 1.3 above, the objective of this study is an attempt to test the following hypotheses:

1.4.1 Hypothesis 1

Improvement in digital readiness through enabling infrastructure could positively impact financial performance in the financial industry.

1.4.2 Hypothesis 2

Improvement in digital readiness through internet affordability could positively impact financial performance in the financial industry.

1.4.3 Hypothesis 3

Improvement in digital readiness through skill and education could positively impact financial performance in the financial industry.

1.4.4 Hypothesis 4

Market-based measures of financial performance respond different to variations in digital readiness when compared to accounting-based measures of financial performance.

1.5 SIGNIFICANCE OF THE STUDY

According to the world economy report by Hawksworth, Clarry and Audino (2017), it is projected that emerging market economies could grow around twice as fast as most advanced economies, ultimately surpassing some of the G8 economies by 2050. This study pays attention to Brazil, Russia, India, China and South Africa because these are the biggest economies in emerging markets (Ndlovu and Alagidede, 2018). These economies have become a focal point of debate in various forums, therefore, the study of the digital innovations on financial performance of financial companies in these economies is contemporary.

In fact, Citi (2016) noted that China has emerged as one of the countries with the fastest growth in FinTech start-ups as well as boasting to have the largest e-commerce system in the world. This is because China has high national internet and mobile penetration while India is poised to be the next biggest contender due to its sheer population size (1.2 billion) and 85 per cent of mobile phone penetration (Citi, 2016). If the sudden increase of FinTechs is driven by enabling infrastructure, affordability of internet and / or the skill levels, the main question that should occupy the minds of stakeholders in the financial industry is whether these digital enabling environments is working in favour of or against the broader sector?

According to the Digital Vortex adapted from Bradley, Loucks, Macaulay, Noronha and Wade (2015) in Appendix A, financial services are at the centre of digital disruptions. For example, according to Citi (2016), banking revenue in the United States of America is already impacted by approximately 10 per cent and this is expected to increase to about 17 per cent by 2023. This is another motivation why a study on the impact of digital readiness on finical performance is long overdue.

It is also noted that BRICS countries are not at the same level of digital developments. For example, according to the Digital Evolution Index adapted from Chakravorti and Chaturvedi (2017) in Appendix B, South Africa and Brazil are represented as ‘Watch Out’, an indication of low digital evolution score and low rate of change in digital evolution. India and Russia are represented as ‘Break Out’, an indication of low digital evolution score and high rate of change in digital evolution. China is represented as ‘Stand Out’, an indication of high digital evolution score and high rate of change in digital evolution. Perhaps this elevated status for China explains why the country is the home of some of the world’s largest FinTechs (Citi, 2016), however, little is known about the implications for financial performance of financial firms.

This research project intends to continue the line of research initiative by Ndlovu and Alagidede (2015) on the determinants of financial performance and a

subsequent publication on industry structure, macroeconomic fundamentals and profitability (see Ndlovu and Alagidede, 2018). The glaring gaps from previous literature is the lack of digital readiness as a potential driver of financial performance in financial firms. Understanding the impact of digital readiness on financial performance of financial firms has become even important given the speed and complexity of changes that is brought by the 4IR, which has a potential to either advance or corrode financial performance of incumbent financial firms.

Previous studies have found questionable evidence on the relationship between digital readiness and economic outcomes (see Armstrong, 2020; Ali, 2018). This conundrum could be a result of the fact that previous research efforts were not necessarily based on longitudinal research designs but on generic surveys, rudimentary data analysis or limited focus to a specific organisation. This study is an attempt to close this shortcoming by employing quantitative models based on a longitudinal research design at a country-industry level which captures long run effects and whose outcomes is hoped to improve the debates on whether digital readiness has an impact on financial performance.

In fact, regulators should be reflecting on the effects of 2008 financial crisis which was caused by financial engineering innovations and start contemplating whether history could repeat itself in a different fashion through digital innovations? It remains to be proven whether the sudden increase in FinTech start-ups has already started to dilute the longstanding profitability and growth dominance of financial firms or the incumbent financial firms are equally enjoying the benefits brought about by the recent digital progress?

In summary, contributions of the study are threefold:

[1] The study is using a longitudinal research design based on the APT quantitative model which incorporates the recent frameworks that are now being developed as a response to 4IR, specifically incorporating digital readiness components as part of the model in order to explain variations of financial performance in the financial industry. This is an opportunity to contribute towards the development of theories which were developed before the 4IR era and

therefore may now pose partial relevance to reality as well as introducing novel and disruptive research designs in digital business.

[2] The study attempts to ascertain whether there is a positive or negative relationship between digital readiness and financial performance. Where a positive response is found, that could be an indication that the traditional financial firms still command a dominant presence in the financial industry despite the competition presented by new industry entrants such as FinTech firms, and the opposite could be true.

[3] The study also attempts to determine whether market-based financial performance measures respond better to variations in digital readiness when compared to accounting-based measures of financial performance. This hypothesis is motivated by a possible loss of pertinent information during the compilation of financial statements and aggregation of information in the computation of financial performance measures such as ROE which could dilute the direct impact of digital readiness.

1.6 DELIMITATIONS OF THE STUDY

This study is a partial application of the WEF NRI framework on financial performance of financial firms, more specifically banks, insurance, investment firms and real estate firms in BRICS countries. As such, this study only examines the impact of digital readiness arm of the WEF NRI framework because the model presents infrastructure, affordability and skills as foundational drivers of digital readiness.

1.7 DEFINITION OF TERMS

Digital Readiness Index is the combined effect of infrastructure readiness, internet affordability and skill levels to the nation's preparedness for the networked world.

Digital Readiness Sub-Indexes refers to infrastructure readiness, internet affordability and skill levels.

Financial Performance only refers to equity returns as measured by market capitalisation and profitability as measured by ROE.

Equity Returns as measured by market capitalisation represents the market value of a listed entity.

ROE is a profitability measure based on shareholders' invested capital.

Emerging Markets only refers for Brazil, Russia, India, China and South Africa.

Fourth Industrial Revolution is a new era that builds and extends the impact of digitization in new and unanticipated ways.

FinTech refers to a technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions.

1.8 ASSUMPTIONS

Assumption 1: Infrastructure readiness, internet affordability and skill levels are the foundational determinants of digital readiness, and therefore determinants of financial performance.

Assumption 2: Market-based measures of financial performance are more responsive to external shocks compared to accounting measures of financial performance.

Assumption 3: The growth of FinTech start-ups has potential to shrink the share of revenues and thus profitability and growth of incumbent financial firms.

1.9 OUTLINE OF THE STUDY

This study is made up of six chapters, which includes this introduction and the following sections:

- Chapter 2 is a literature review which covers financial and technological developments, theoretical and empirical discussion as well as the research hypotheses;
- Chapter 3 describes the research methodology, data sources and definitions and well as the analytical approaches to data analysis;
- Chapter 4 presents and analyses the results of the study;
- Chapter 5 discusses the empirical findings and key findings; and
- Chapter 6 summarises the key findings, policy and strategy implications.

CHAPTER 2. LITERATURE REVIEW

This section traces financial industry developments in respective BRICS countries in order to lay a foundation for the status qou. The second section revisit general financial technology disruptions across banking, insurance, investments and real estate industries. The last section is a deeper review of discussions and debates on theories and empirical evidence on financial returns and digital readiness, specifically, on infrastructure readiness, internet affordability, skill levels as well as an empirical comparison between market-based financial measures and accounting-based financial performance measures.

2.1 FINANCIAL INDUSTRY DEVELOPMENT

The below section is a brief country specific analysis on financial industry development trends. In general, the assessment suggest that BRICS financial industry has been on a growth trajectory in the recent past.

2.1.1 *Brazil*

Similar to the accounts made by Min, Weidong, Jingtong, Xinzhe and Qiyue (2018) on Chinese financial industry development in section 2.1.4 below, Moyo, Khobai, Kolisi and Mbeki (2018) found that Brazil also went through similar major reforms in the late 1980s where interest rates, exchange rates and capital controls were abolished. Resultantly, banks started to re-organise and diversifying as universal banks while some banks were privatised.

According to these authors, the number of banks increased from 111 in 1998 to 180 by 2017. Over the past decade, Brazil's financial system grew in size and composition due to financial inclusion, growth in derivatives and securities market as well as the free participation of institutional investors. By and large, the said reforms helped Brazil to withstand the 2008-2009 financial crisis, however, the same cannot be said about the growth of the stock market largely due to political upheavals, especially between 2013 and 2015. Recently, Macrotrends (2020) claim that Brazil's stock market has shown a positive correction, where a year-

on-year growth of 40.91 per cent,25.08 per cent,15.03 per cent, 31.58 per cent was recorded for year 2016, 2017, 2018 and 2019 respectively.

2.1.2 *Russia*

In Russia, the financial industry has largely been influenced by the central bank's interventions. According to Ono (2017), the Central Bank of Russia repeatedly attempted to prevent the ruble from appreciating sharply between 2005 and 2007. By 2008, the Central Bank of Russia implemented large-scale interventions in the foreign exchange market however this time around to prevent ruble's depreciation.

In 2011, Ono (2017) further observed that money supply increased dramatically as a result of an elevated credit interest. Further growth of banking system claims increased by RUB 4.5 trillion, RUB 5.2 trillion, RUB 7.4 trillion and RUB 3.2 trillion in 2012, 2013, 2014 and 2015 respectively, although they later decreased by RUB 800 billion in 2016. A notable trend in 2013 was the rise in money supply and bank loans. In the same year the ruble exchange rate plunged, which prompted the Central Bank of Russia to intervene again in order to stabilise the ruble rate (Worldbank, 2015).

The account of volatile financial events above is reminiscent of a financial system that has largely been plugged by uncertainty and instability.

2.1.3 *India*

As a consequence of sequential financial industry developments in the past 25 years, India has seen a momentous evolution in interest and exchange rate market (Mohan and Ray, 2017). On the other hand, a study by Verghese (2018) reveals that India's financial services sector is highly regulated. Although some of the reforms included the introduction of new private sector banks to induce competition, state-owned banks continue to dominate the market. Verghese (2018) is however positive about the rate of transformation in the financial system because of its faster growth rate compared to other countries. Mohan and Ray

(2017) believe that the reduction in government ownership in financial entities could enhance advancement in the financial industry.

Furthermore, the advancements in financial industry could be accelerated by the mobile phone diffusion which was expected to rise to 90 per cent by 2020 from 60 per cent in 2017 while the smartphone users were estimated to increase to approximately five hundred million people by 2020(Citi, 2016). It is for this reason that the investigation of digital readiness in BRICS countries is becoming important in order to ascertain the spill over effects on financial performance of financial firms due of this increasing speed of technological diffusion.

2.1.4 *China*

Min *et al*. (2018) found that financial institutions in China has increased rapidly in variety and numbers since the implementation of financial consolidation, crisis management and opening-up policy. These reforms have allowed Chinese Banks to be competitive in the world markets and subsequently taking a leading and centre stage in the global financial markets.

According to Min *et al*. (2018), China's banking sector is now ranked as one of the largest sectors in size and its banks are regarded amongst the world's most systematically important banks. This is because the number of Chinese banks that accounts for the top 20 profitable banks in the world has astoundingly improved since reforms were implemented. These authors show that in 1996, only the Bank of China was classified amongst the world's top twenty biggest banks. By 2016, nine of the Chinese banks were amongst the top twenty big banks in the world, with profits representing just above fifty percent of the top twenty profitable banks across the globe (Min *et al*., 2018).

These authors further reported that the Chinese stock market capitalisation was ranked second in 2016, accounting for approximately RMB 50.8 trillion. In addition, they observed that insurance industry assets amounted to approximately RMB 15.12 trillion which was twenty-three times their 2002 totals. Based on this quantum shift in value of financial activity, there is no doubt that

China has emerged as one of the frontrunners in financial system development in the world over.

2.1.5 *South Africa*

Muyambiri and Odhiambo (2018) demonstrate a progressive trend in financial industry development since 1990 to 2014. This could in part be as a result of the transition period from a previous regime that was largely excluded from the international markets during the Apartheid Era to a more liberal financial system that could be accessed by other global financial players. These authors point to the increased efficiency of the financial industry in credit creation. The authors however caution that despite the clear improved trend in financial growth and investments, the economic development expectations could not be met due to an unstable exchange rate, highly literate human capital expense, stringent employee regulations and soaring crime levels.

Despite the above challenges, recent research efforts claim that the South African financial sector is one of the robust financial systems in the world which is attributed to its sound regulatory framework and solid macroeconomic policies that helped the sector to withstand the contagion and catastrophic effects of the 2008-2010 worldwide financial crisis (see Maredza and Ikhide, 2013). On the stock market front, market capitalisation on the Johannesburg Stock Exchange has grown from USD 151 billion to USD 891 billion during the 2002 to 2018 period (see Ceicdata, 2018). This view is symptomatic of a growth trend in equity returns during the period under study.

2.1.6 *Summary*

The Brazilian financial system went through major reforms which has helped the banking system to remain stable, with slight instability observed in the stock market. In Russia, the financial industry has remained under the control of the central bank largely to manage the exchange rate that is highly sensitive to external shocks.

India’s financial industry remains dominated by state-owned banks, however, its financial growth potential is positive due to a promising growth trajectory in technological advancements such as internet and mobile phone penetration. The Chinese financial system went through major reforms in the late 1990s. In recent past, Chinese Banks have been ranked amongst some of the world’s most profitable and systematically important banks. Its financial industry in general has enjoyed significant growth both from a profitability view as well as market capitalisation. Similarly, the financial industry in South Africa has shown some notable positive developments since the end of Apartheid.

In general, the financial industry in BRICS countries has developed to compete in world standards, thus, this study is not only relevant to emerging markets but to comparable economies as well.

The below section is a general discussion on some of the financial technological disruptions across banking, insurance, investments and real estate industries.

2.2 TECHNOLOGICAL DISRUPTIONS

The review below shows that most technologically disrupted spaces in the financial industry are the payments solutions, deposits and lending in banking industry, customer acquisition and operations in insurance industry, advisory in investment industry and property development and management in real estate industry. FinTech companies have been the source of these disruptions across industries.

Financial Stability Board (2020) defines FinTech as “technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets and institutions and the provision of financial services”. Over the recent past, a notable trend has been the increase in the number of new FinTechs and that potential introducing competition in the financial industry. According to Musabegović, Özer, Đuković and Jovanović (2019), the number of new companies in the FinTech

industry was modest between 2008 and 2010, however, this number has more than doubled in recent past.

The following section is a general discuss on some of the recent disruptions in various industries of the financial industry.

2.2.1 *Banking Industry*

Musabegović *et al*. (2019) identified payments and settlements solutions, deposits and peer-2-peer lending, financial management, capital raising and banking operations as some of the business solutions within the banking sector that are being disrupted by FinTechs.

In addition, Gomber *et al*. (2018) identifies customer acquisition, real-time transaction and approval, credit scoring and monitoring, customer retention, distributed ledger technology and digital currencies, cross-border remittances and foreign exchange, open banking platforms and crowdfunding as some of the FinTech disruptions in banking history.

The above business solutions make up some of the core operations in the banking industry. These industry wide disruptions could possibly imply that organic growth of the banking institutions may be at risk while revenues and profitability could already be under threat (Gomber *et al*., 2018).

2.2.2 *Insurance Industry*

In the insurance industry, Musabegović *et al*. (2019) identified customer acquisitions, operations, personal insurance, commercial insurance, and peer-2-peer insurance as some of the business solutions that are being disrupted by FinTechs. Although technological disruptions in the insurance industry have been slower compared to the banking industry, Sen and Lam (2016) believe that the recent advances in technological diffusion could significantly change insurance solutions in the industry.

These authors state that developments in technology and data insights could improve and alter product development, customer acquisition, underwriting and claims management. In particular, these authors believe that many insurance focussed FinTech start-ups are working on capturing potential profitable segments along the insurance end-to-end value chain, including the digitalization and automation of mundane and repetitive processes.

2.2.3 *Investments Industry*

Investments managed through robo-advisors has also seen an increase in the number of players that are disrupting traditional investment management (Musabegović *et al*., 2019). Gomber *et al*. (2018) describes robo-advisors as automated acquisition of information and data processing that enables the provision of investment proposals with minimal human involvement.

These authors further note that social trading platforms are presenting potential and current investors with some possibilities of exchanging investment solutions because these platforms have been found to be cost effective and offer customer-oriented alternative for setting up and managing investors' portfolios.

2.2.4 *Real Estate Industry*

In real estate industry, property development and management, leasing, financing and investment are some of the FinTech businesses that Musabegović *et al*. (2019) have identified as the centre of FinTech disruptions.

In the recent past, a rise in hybrid FinTech companies that border between banking and real estate solutions has also started forming up. Bughin (2017) observed that while home services side of banking is being transformed by software backed search engines, the actual financing platforms in certain banks now provide virtual-reality online apps that provide clients with abilities to access a property's past sale transactions, community and neighbourhood facilities before submitting a mortgage application directly from the banking online platform.

According to Musabegović *et al*. (2019), the key motive why FinTech companies are capable of making an impactful disruption on the industries above comes from cost efficiencies that are presented by digital technology developments, better quality and innovative services for consumers and limited regulatory burden. What has not been tested is the potential impact of these digital disruptions on financial performance in banking, insurance, investments and real estate industries.

2.3 THEORETICAL FRAMEWORK

The below section tracks the origins of the NRI and its Digital Readiness Index (DRI) as well as putting forward the arguments for the chosen framework. In addition, theories that attempt to answer questions on the determinants of equity returns are briefly discussed as well as an attempt to link these to some of the recent digital advances.

2.3.1 *Digital Readiness Index*

The NRI was first developed by Kirkman *et al*. (2002) as a measure of the nation's preparedness for the networked world. These authors found scanty literature to guide their conviction in terms of the impact of digital readiness on economic competitiveness. Subsequently, the Baller *et al*. (2016) study makes a strong attempt to link digital diffusion and economic impact. Infrastructure readiness, internet affordability and skill levels are specifically mentioned as the fundamental determinants for digital readiness.

These authors defined digital readiness as the sum average of infrastructure readiness, internet affordability and skill levels. Infrastructure readiness was defined as the sum average of the percentage of electricity production, mobile network coverage and internet bandwidth, internet affordability as the sum average of prepaid cellular tariffs, broadband internet tariffs and telecommunications industry concentration and skill level as quality of education, adult literacy rates and quality of STEM subjects.

Later on, Chakravorti and Chaturvedi (2017) introduced the Digital Evolution Index which also sought to estimate the digital readiness state of a country. According to these authors, the Digital Evolution Index indexes that closely mirror the NRI digital readiness conditions include access to infrastructure and digital uptake, however, unlike in the NRI framework, the effect of skills and education is not clearly represented by the Digital Evolution Index.

In 2018, the Economist Intelligence Unit introduced the Technological Readiness Ranking Index, another attempt to measure digital readiness of nations, which is made up of access to the internet, digital infrastructure and openness to innovation. The variables from the Technological Readiness Ranking Index that make a close alternative to the NRI framework are internet usage and mobile phone subscriptions. However, variables such as infrastructure and skills as defined by the NRI framework are not represented in the Economist Intelligence Unit framework.

Recently, Dutta and Lanvin (2019) redesigned the NRI based on four pillars, namely technology, people, governance and impact, totally diluting the previous DRI pillar, including its indexes, which makes it impossible to compare the current NRI to previous versions of the NRI framework.

Despite these glaring misalignments in the frameworks that attempt to measure digital readiness, Cann (2016) argue that infrastructure is a key determinant of digital readiness alongside affordability and skills, thus, the 2016 NRI framework remains very relevant to this study compared to the other frameworks, including the recently redesigned NRI 2019 version.

2.3.2 *Equity Returns*

There are also other widely debated theories that attempt to answer questions on the drivers of equity returns. The most widely studied theories include the Capital Asset Pricing Model (CAPM) developed by Sharpe in 1964, the Efficiency Market Hypothesis (EMH) developed by Fama in 1970 and APT developed by Ross in 1976.

According to Sharpe (1964), the CAPM model asserts that there is a relationship between equity returns and its risk. On the other hand, the EMH model argue that efficient equity prices are primarily driven by either historical, public or private information sets (Fama,1970) while APT was developed on the principle that expected equity returns can be predicted by macroeconomic variables.

Ross (1976) developed the APT model as an alternative to the CAPM model because the CAPM's has been lambasted for it being too simplistic based on unrealistic assumptions (Kisman and Restiyanita, 2015). Recently, Naseer and Bin Tariq (2015) critiqued the EMH model citing the fact that markets may not always be efficient while Staikouras (2005) argue that the APT model may not always hold.

The above debates and arguments are a clear gap in understanding and alignments as to what drives equity returns in general. This gap in theory and literature is further exacerbated by the recent financial and digital innovations which could have an impact on equity returns although previous empirical evidence suggest that digital innovations have temporary effects on equity returns (Madsen and Philip Davis, 2006).

Authors such as Hansen *et al.* (2018) and Singla *et al.* (2018) argue that Technological Push innovation capabilities play an integral part in driving financial results in manufacturing industry. Technological Push theory suggest that it is the digital progress that determines the adoption and impact of new technologies (Hansen *et al*., 2018). Although there is evidence that theories on digital innovation have had impact on industries such as manufacturing, little is known on how digital readiness impacts equity returns in the financial industry.

In general, there appear to be some sort of association between digital progress and commercial outcomes. This is because authors such as Choi (2018) argue that market demand does not precede digital innovation, yet it can be argued that digital innovations could potentially lead financial performance although the relationship between digital innovations and financial equity returns is not yet known.

The following section is a review of discussions and debates on digital readiness empirical findings.

2.4 EMPIRICAL REVIEW

Amongst BRICS countries and using the 2016 Global Technology Information Report to measure digital readiness, Baller *et al*. 2016 ranked Russia first, Brazil second, South Africa third, China fourth and India fifth with a digital readiness percentage score of 55 per cent, 51 per cent, 48 per cent, 47 per cent and 44 per cent respectively.

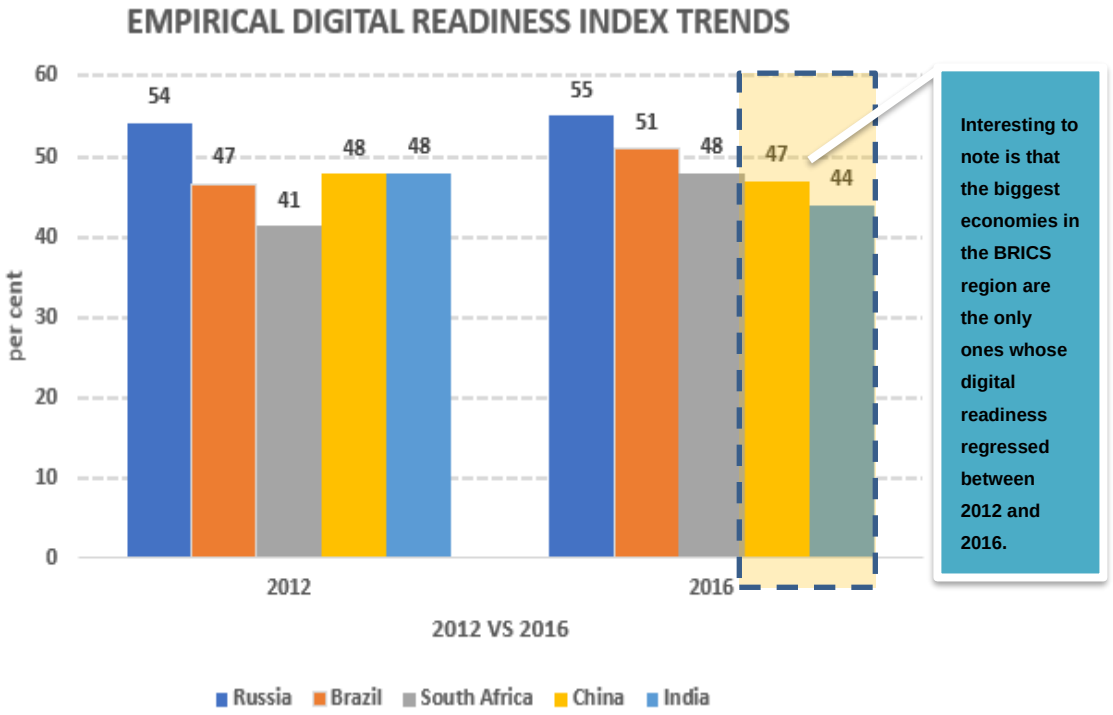


Figure 2: 2012 vs 2016 Digital Readiness Trends

Source: Baller et al. 2016

These results however contradict the previous view by Citi (2016) who stated that China is amongst the world's top leading countries in digital progress. The view presented above is however in line with the 2018 Economist Intelligence Unit Technological Readiness Ranking Index where Russia was ranked higher than all other BRICS countries. In fact, the above observed contradicting rankings are not limited to inter-country disparities, for example, in 2005, China was ranked 64 in the NRI yet the Technological Readiness Ranking Index placed China in

number 32, a clear demonstration of intra-country misaligned conclusions from these two DRI frameworks.

The above contradictions are a confirmation that previous attempts of measuring a country's digital readiness status seem not to align across various frameworks which makes it difficult to accurately conclude on which of the frameworks is most reliable to be trusted. In addition to the above misalignments, Machado, Winroth, Carlsson, Almström, Centerholt and Hallin (2019) introduced additional unrelated six digital readiness dimensions which are also misaligned to the common methods of measuring digital readiness as stated above.

Similarly, James (2008) concluded that NRI and the Digital Opportunity Index have resulted in murky understanding as to what exactly defines digital readiness. This is because the author argue that certain indexes are marked by obvious flaws and possibly misaligned because they confuse inputs and outputs of the models/framework. In addition, Vidruska (2016) argue that digitisation international measures have not been discovered because certain digital readiness frameworks use different measures while others are comparable.

Arguments by authors such as James (2008) and Vidruska (2016) suggest that the use of any digital readiness framework is most likely different and contextual to what data is used as well as the calculations made thereof. For example, in the NRI from a study by Kirkman, Osorio and Sachs (2005), the digital readiness rankings for Brazil, Russia and South Africa are different to what is presented in Figure 2 above.

Nonetheless, Cann (2016) contends strongly that infrastructure is a key determinant of digital readiness alongside affordability and skills. It is for this reason that this study has made a partially adoption of the WEF NRI framework by specifically using only the dimensional inputs of digital readiness, namely, infrastructure readiness, internet affordability and skill levels as the main determinants of financial outcomes, namely profitability (ROE) and market growth (equity returns).

The below section revisits some of the past discussions and debates on infrastructure readiness, internet affordability and skill levels.

2.4.1 *Impact of Infrastructure readiness*

Ketterer *et al.* (2016) attempted to investigate digital readiness in financial services. Aligned to the WEF NRI framework, these authors also identified infrastructure and skilled workforce as some of the key foundational elements of ensuring digital transformation if financial set ups such as banking and insurance institutions.

A study that focussed on the determinants of digital readiness in Sri Lanka does provide guidelines on which type of electrical production is conducive for supporting digital readiness. Davidrajuh, Karamat and Dhayalan (2008) categorically state that to improve digital readiness, the cost of electricity power generation and distribution should be within the price range that users can afford. Secondly, the power generation should be reliable and available to be used as and when required. Thus, for a country to achieve desired levels of digital readiness, electricity production should be reliable, distribution should be uninterrupted, and consumption should be at a reasonable cost.

2.4.2 *Impact of Internet affordability*

Supporting the WEF NRI framework, Wyckoff and Pilat (2017) revisited the main questions on digital transformation in the G20 countries and highlights the fact that access to internet is very critical in maximising the benefits of digital technologies. Furthermore, these authors observed that the decrease in mobile access prices due to competition has a direct impact on mobile subscriptions. Kirkman *et al*. (2002) concluded that exorbitant cost of internet access is an obstacle for digital preparedness of a country.

On the other hand, Lambrechts and Sinha (2019) point to the fact that emerging market economies have burning priority problems to deal before looking at the affordability of broadband internet and infrastructure to distribute the internet.

Amongst others, these issues include bribery and corruption, starvation, wealth divide, unstable and unreliable electricity supply, high levels on unemployment and sub-standard levels of education. These misplaced but necessary priorities could be hurting the progress and maturity of country digital readiness, economic growth and financial performance in general because internet usage has been found to be impacted by poor levels of internet quality and affordability (Dao, 2017).

2.4.3 *Impact of Skill levels and Education*

Machado et al. (2019) evaluated digital preparedness of seven manufacturing companies in Sweden and identified the lack of knowledge and skills to be one of the challenges in achieving digital readiness. On the other hand, Wyckoff and Pilat (2017) find that skills and education are key determinants on how digital technologies are used. These authors further argue that the higher the education the more the usage and adoption of digital platforms. For example, tertiary educated and qualified users were found to perform above average internet tasks compared to secondary level users. The authors conclude that education plays an important role in determining technology and internet adoption.

From the above upshot, there seem to be contrasting views as to the impact of skill levels in enabling economic growth as outlined above vis-à-vis its impact in enabling digital readiness of an economy. On one hand, highly skilled labour force come at a high cost and thus impact economic growth negatively. On the other hand, high skill levels are a necessary antidote for digital readiness of an economy. Assessing these contrasting views through an empirically tested method of examining the impact of skill levels on financial industry performance could assist in either affirming or disproving whether high skill levels are a curse or a boon.

2.4.4 *Market-based vis-à-vis accounting-based financial measures*

Previous research efforts have tried to compare accounting-based measures of financial performance vis-à-vis market-based measures of financial performance

and there has been mixed outcomes. For example, Tayeh *et al.* (2015) investigated how accounting-based measures of financial performance fare against market-based measures of financial performance in relation to a firm's investment in information technology. These authors found that market-based measures of financial performance were preferred over accounting-based measures of financial performance because market-based measures of financial performance not only capture broad concepts like business performance but also link the firm's strategy with its performance.

On the contrary, Conyon and He (2014) observed a general analyst preference for accounting-based performance measures compared to market-based performance measures when determining the tenure of a Chief Executive Officer in Chinese listed firms. However, these authors further observed that the weight attached to stock market performance measures is significantly increased after the governance reform of a firm. In line to Tayeh *et al.* (2015) and later observations by Conyon and He (2014), this study acknowledges the possibility that accounting measures of profitability such as ROE could lag the speed of digital changes, thus, market-based measures of financial performance should capture the changes of the digital landscape as soon as the changes take effect.

2.5 CONCLUSION

The above literature provides strong evidence to believe that BRICS financial industry has improved in recent past. Similarly, technological developments have also destabilised the traditional financial business models and this has come with positives and negatives. The positives point to the fact that previously financial excluded sectors of the society can now access financial services through the innovative offerings from the FinTechs (Demir, Pesqué-Cela, Altunbas and Murinde, 2020; Senyo and Osabutey, 2020). The negatives emanate from increased competition as well as potential erosion of sources of revenue for incumbent firms (Jagtiani and Lemieux, 2017).

The review of literature on digital readiness suggests the following research hypotheses.

2.5.1 Hypothesis 1

Improvement in digital readiness through enabling infrastructure could positively impact financial performance in the financial industry.

2.5.2 Hypothesis 2

Improvement in digital readiness through internet affordability could positively impact financial performance in the financial industry.

2.5.3 Hypothesis 3

Improvement in digital readiness through skill and education could positively impact financial performance in the financial industry.

2.5.4 Hypothesis 4

Market-based measures of financial performance respond different to variations in digital readiness when compared to accounting-based measures of financial performance.

CHAPTER 3. RESEARCH METHODOLOGY

A high-level justification of the research approach and design is discussed before describing data and data sources. This is then followed by a research data analysis which represent the main models that have been identified as appropriate to scientifically address the research questions through causality and regression specifications. The sections conclude off by describing diagnostics and robustness tests that are meant to ensure that the specifications and results thereof can be relied upon in answering the research questions and ultimately be trusted to guide policy and strategy direction.

3.1 RESEARCH APPROACH

This research follows a quantitative approach based on secondary panel data in view of determining the casual relationship and effect between country level digital readiness and financial performance of financial companies in BRICS countries. In line to quantitative panel data model approach that was recommended by Arellano and Bond (1991) and subsequently adopted by authors such as and Chen, Zeng and Lee (2015) and Borio, Gambacorta and Hofmann (2017), a quantitative panel data approach is also preferred for this study because its panel data structure combines time series data as well as cross-section data from a combination of country level, industry level and firm specific data points.

These authors further highlight that the combination of time series and cross-sectional data is in most cases preferred as a quantitative research approach because it results in higher degrees of freedom which produces efficient estimates especially in the regression analysis in section 4.3 below.

3.2 RESEARCH DESIGN

This quantitative approach is a pioneering scientific study on digital readiness and financial performance because previous studies have either applied elementary data analysis (see Armstrong, 2020) or employed a quantitative

method based on data collected through surveys (see Baller *et al*., 2016). Both these methods have not been scientific to justify sound conclusions.

Unlike the previous studies that mainly focussed on generating a DRI based on a year worth of data, this enquiry takes a longitudinal design over a 10-year period to capture the long-term effects of digital readiness variations and how these variations impact the changes of financial performance in the financial industry. This longitudinal design is in line to previous studies that also studied the determinants of financial performance (see Ali, 2018; Aoko, 2017; Borio *et al*., 2017; Chen *et al*., 2015; Owoputi, Olawale and Adeyefa, 2014).

This study is based on 1 224 firms across BRICS countries where 135, 41, 711 and 337 representing banks, insurance and investments and real estate firms respectively across BRICS countries. This sample of 1 224 companies are financial firms which are listed in their local stock exchange. According to Nustini (2003), stock exchange listed firms can easily be categorised into industries while their financial data can be relied upon since these firms are subjected to stock exchange compliance requirements and their financial statements are audited on a regular basis. It is for this reason why this study is limited to listed firms because it allows for the categorisation of companies into their respective industries.

3.3 DATA SOURCES AND DATA DESCRIPTIONS

Bloomberg was specifically chosen as a source for financial performance variables because it is widely used as a reliable source of company level financial data by individuals, academics and institutions alike. Data extraction for financial data was limited to listed financial firms because listed firms can easily be categorised into industries (Nustini, 2003).

In line to data sources used by Baller *et al*. (2016), some of the digital readiness independent variables and all macro-economic control variables were obtained from World Bank Databank. Like Bloomberg, World Bank Databank is a reliable source of country level data (World Economic Forum, 2016a). Where data quality

or completeness was questionable, alternative better data sources were used as illustrated in Appendix D below.

The financial and digital variables were sourced for a 10-year timeframe in order to ensure alignment between the dependent variables (Equity returns and ROE) and independent variables (infrastructure readiness, internet affordability and skill levels) as well as ensuring that long run effects of digital readiness on financial performance can to captured by the data points. The recent 10-year period was chosen because data availability and quality of data for the countries under study has improved over the recent past. Extending the period to beyond 2009 going backwards could potentially impact data analysis due to poor data quality and completeness.

3.3.1 *Financial Performance*

This study defines financial performance as equity returns as measured by market capitalisation and ROE, a measure of profitability. According to Seth (2020) market capitalisation is the aggregate market value of a company represented in dollar amount. It is a proxy for equity returns which measures the growth of the share price and is a very important financial metric for the shareholders. Similarly, ROE is a widely used financial metric that is broadly reported as a profitability measure. Firer *et al.* (2012) defined ROE as a measure of how the shareholders' capital was used to generate returns.

The difference between ROE and equity returns is that ROE is backward-looking while equity returns is a forward-looking metric, mostly driven by the positive or negative outlook of general growth prospects, which may or may not include digital innovation possibilities.

a. *Market Capitalisation (Equity returns)*

According to Seth (2020), market capitalisation as the dependent variable for the study as well as a proxy for equity returns represents the market value of a listed entity. It is calculated as follows:

$$Market\ Capitalisation = Common\ Shares\ Outstanding * Price \qquad (1)$$

Equation 1: Equity Returns

This study uses the current market capitalization value of the company for the period. For ease of comparison across BRICS countries, market capitalisation was rebased into USD denomination from the data extraction process.

b. *Return on Equity*

According to Firer *et al.* (2012), ROE as control dependent variable is a profitability measure based on shareholders' invested capital. It is commonly measured in percentage terms and is calculated below:

$$ROE = \frac{Net\ Income\ available\ for\ Common\ Shareholders}{Average\ Total\ Common\ Equity}\ x\ 100\% \qquad (2)$$

Equation 2: Return on Equity

3.3.2 *Digital Readiness*

According to Baller *et al*. (2016), digital readiness is made up of infrastructure readiness, internet affordability and skills levels. These indexes for digital readiness are all summed up and the ultimate DRI score is calculated as an average of these measures as illustrated below:

$$DRI\ Score = \sum X/n \qquad (4)$$

Where:

$$X = \ Infrastructure\ Readiness, Internet\ Affordability\ and\ Skill\ levels$$

$$n\ = number\ of\ digital\ readiness\ variables$$

Equation 3: Digital Readiness Index

The digital readiness sub-indexes (independent variables of the study) are discussed in detail below.

a. *Infrastructure Readiness*

Infrastructure readiness includes electricity production, mobile network coverage and internet bandwidth (Baller *et al*, 2016). This study uses access to electricity as a proxy for electricity production, Mobile network coverage and percentage of internet usage as a proxy for internet bandwidth. Access to electricity data was extracted from World Bank Database and is defined as the number of people who have access to electricity as a percentage of the entire population (see The World Bank, 2020). Mobile network coverage data was also extracted from World Bank Database and is defined as the percentage of total population covered by a mobile network signal (see The World Bank, 2020), while the percentage of internet usage data was extracted from the United Nation's International Telecommunication Union (ITU) database and is defined as the number of people using the internet as a percentage of the entire population (see International Telecommunication Union, 2020).

b. *Internet Affordability*

According to Baller *et al*. (2016), affordability includes prepaid cellular tariffs, broadband internet tariffs and telecoms sector concentration. This study uses cellular and fibre subscriptions as a proxy for cellular tariffs and broadband internet tariffs, respectively. The International Telecommunication Union defines cell phone subscriptions as services which offer voice communications while fibre subscriptions are described as fixed subscriptions to public internet with high-speed (see International Telecommunication Union, 2020). Telecoms sector concentration levels is calculated using the Herfindahl Hirschman Index (HHI) as supported Kaplan University (2016:276). It is calculated as illustrated below:

$$HHI = \sum_{i=1}^{n} MSi * 100 \qquad (3)$$

Where:

$$MSi = market\ share\ of\ firm\ i$$

$$n = number\ of\ firms\ in\ the\ industry$$

Equation 4: Telecoms Sector Concentration

For the purposes of consistence across the digital readiness sub-indexes, the resultant HHI was converted to a percentage using a maximum HHI score cap of 10000.

c. *Skill Levels*

This study uses education index as a proxy for skills quality of education and data was extracted from the United Nation's Human Development Report database. It is defined as the average of mean years of schooling of adults and the expected years of schooling of children (see United Nation's Human Development Programme, 2020). The percentage of population with advanced education was used as a proxy for adult literacy rate. The percentage of population with advanced education data was extracted from the World Bank Database and is defined as the number of people with tertiary education as a percentage of active labour force (see The World Bank, 2020). The percentage of STEM graduates was used as a proxy for quality of STEM subjects. STEM data was extracted from United Nations Educational, Scientific and Cultural Organization's (UNESCO) Institute for Statistics database. It is defined as the percentage of male and female graduates from Science, Technology, Engineering and Mathematics programmes in tertiary education institutions (see UNESCO, 2020).

3.4 DATA ANALYSIS MODEL

Firstly, descriptive and trend analysis for both equity returns and digital readiness trends is performed in order to provide a view of the summary statistics and drift of equity returns and digital readiness over the 10-year period. Then, causality analysis is conducted to confirm the flow of influence between equity returns and digital readiness dimensions. Lastly, the regression analysis is meant to capture the impact of digital readiness drivers on equity returns as well as to confirm the differences of impact of digital readiness on market-based financial performance compared to accounting-based financial performance measures.

3.4.1 *Causality Analysis*

Granger (1969) introduced a model to test causal relations, however, causality tests can only be valid if the data series has unit root and is cointegrated. Unit root and cointegration tests are often conducted based on scientifically proven lags, however, Thornton (1994) argue that the choice of lags has been found to be arbitrarily. Thus, the author suggested that lags be based on an appropriate information criterion method. Recently, Lopez and Weber (2017) recommend that the number of lags should be chosen based on the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), or the Hannan-Quinn Information Criterion (HIC). This is because the choice of lags may have an impact on causality test outcomes.

The null hypothesis for equity returns-digital readiness causality as illustrated in equation (4) is that equity returns does not cause digital readiness while the null hypothesis for specification (5) is that digital readiness does not cause equity returns. If the null hypothesis in specification (5) is rejected, the results would be a confirmation that digital readiness Granger-Cause equity returns and vice versa.

$$ER_{it} = \psi_0 + \psi_1(ER_{it} - N) + \psi_2(DR_{it} - N) + \varepsilon_{it}) \quad (4)$$

$$DR_{it} = \psi_0 + \psi_1(DR_{it} - N) + \psi_2(ER_{it} - N) + \varepsilon_{it} \quad (5)$$

Where:

ER = Equity Returns

DRI = Digital Readiness Index

N = Dynamic AIC lag order selection per country per industry as illustrated in Appendix E.

Equation 5: Granger-Causality Specification

3.4.2 *Generalised Method of Moments Estimator*

The Generalised Method of Moments (GMM) is a regression estimator that was developed by Arellano and Bond in 1991 and has been widely used in panel data estimations since then. It has been widely researched and preferred in financial profitability studies due to its reliability in minimising the correlation between idiosyncratic component of the specification and independent variables, otherwise known as endogeneity (see Alagidede and Ibrahim, 2017; Borio *et al*., 2017 and Chen *et al.*, 2015).

Thus, equation (6) below is a GMM specification that is constructed based on the APT foundations. Although Staikouras (2005) argue that APT model may not always hold, Sekreter (2017) still believes that the APT model is superior to other models such as CAPM and EMH because it assumes that equity returns are affected by *n* factors. The advantage of the APT model therefore is that it can be adapted to reflect knew knowledge or assumptions such as digital innovations. It is for this reason that the APT model is adapted in this study.

The APT-GMM regression is estimated as follows:

$$ER_{it} = \beta_0 + \sum_{i=1}^{n} \beta_1 Inf + \sum_{i=1}^{n} \beta_2 Aff + \sum_{i=1}^{n} \beta_3 Ski + \sum_{h=1}^{5} \delta_h W + \mu_i + \varepsilon_{it} \quad (6)$$

Where:

ER = Equity Returns (dependent variable)

Inf = Infrastructure readiness (independent variable)

Aff = Internet Affordability (independent variable)

Ski = Skill levels (independent variable)

W = Macroeconomic factors (control variable)

Equation 6: APT-GMM Regression Specification

where ER*it* is the equity returns of company i at period t, *Inf* represents the sum average for access to electricity, mobile network coverage and percentage of Internet usage, *Aff* represents the sum average for cellular subscriptions,

broadband subscriptions and telecoms sector concentration, *Ski* represents the sum average for education index, labour force with advanced education and STEM graduates, *W* represents macroeconomic control variables*(*Gross Domestic Product, Interest Rates, Exchange Rates, Inflation Rates and Unemployment*)*, μ_i represents unobserved component and ε_{it} is the idiosyncratic component.

Macroeconomic variables are included in the specification as control variables because prior studies found these external effects to be significant in the estimation of firm returns (see Patro, Wald and Wu, 2002; Ward and Price, 2006; Ndlovu and Alagidede, 2018). In fact, control variables are meant to reduce concerns about variable omission bias (see Anwar and Sun, 2011; Asongu, Roux and Biekpe, 2018).

The ROE-GMM regression specification is a robustness measure that is also estimated the same way as the *ERit* specification specifically to test whether market-based measures of financial performance respond different to digital readiness when compared to accounting-based measures of financial performance.

One of the main challenges of using the GMM estimator is that is does not definitively provide guidance on how to select instrumental variables, however, as supported by recent studies from authors such as Alagidede and Ibrahim (2017), Borio *et al*. (2017), and Younas and Nandwa (2010), the first difference or lagged values of independent variables has been found to yield reliable results. As such, this study employed lagged values of independent variables.

3.5 MODEL VALIDITY AND ROBUSTNESS TESTS

Panel unit root test is a model validity and robustness tests for the causality specification while the Hausman tests satisfy model validity and robustness test for the GMM specifications.

3.5.1 *Panel unit root tests*

Unit root testing is a prerequisite for estimating time series models as a first step to determine if data is stationarity because non-stationary data can lead to spurious regressions. According to Jankee (2006) and Boulila and Trabelsi (2004), the most common practice to determine stationarity is by employing the Augmented Dickey Fuller (ADF) test, however, most recent studies argue that panel unit-root tests are preferred as compared to traditional unit-root tests (Hassan, Azali and Lee, 2014). As such this study employed the ADF test which was found to be appropriate for an unbalanced data set.

3.5.2 *Hausman tests*

According to Hausman and Taylor (1981), if the two GMM estimators are not significantly different (*Ho*), the random effects specification is considered to be more efficient and therefore preferred. Recent studies by authors such Petria, Capraru and Ihnatov (2015) and Owoputi *et al.* (2014) have also recommended the use of the Hausman test as a reliable and robust measure of choosing between fixed and random effects specifications. Consequently, this study used the Hausman tests to choose the most reliable specification between fixed and random effects estimators.

CHAPTER 4. EMPIRICAL RESULTS

Descriptive statistics for digital readiness and equity returns are presented first. This is then followed by a trend analysis for both digital readiness and equity returns before exploring causality between financial performance and digital readiness. Regression analysis is presented last.

4.1 DESCRIPTIVE AND TREND ANALYSIS

The attributes of data are analysed below mainly based on mean and standard deviation of both digital readiness and equity returns as well as the trend analysis that is also expected to provide a view of the linkage between digital readiness and equity returns. Below is a detailed discussion of descriptive statistics and trend analysis.

4.1.1 *Descriptive Statistics: Digital Readiness*

Table 1 below represent digital readiness descriptive statistics per country. Russia and China are showing higher levels of DRI compared to other countries where Russia is slightly higher than China at 73.45 per cent while China is at 72.15 per cent. Based on the standard deviation statistic, China exhibits very high variation from the mean as compared to Russia which means that over the 10-year period, China has experienced excessive instability of its DRI score, yet Russia remained pretty much stable.

Second to Russia and China is Brazil and South Africa with an average DRI score of 66.39 per cent and 64.79 per cent, respectively. The variation in their DRI is almost the same over the 10-year period although slightly lower than China which means that the variation in their DRI score remained volatile as well when compared to Russia.

Table 1: Digital Readiness Descriptive Statistics

INDUSTRY	BRAZIL	RUSSIA	INDIA	CHINA	SOUTH AFRICA
Mean	66.390	73.457	50.798	72.157	64.794
Standard Deviation	4.681	1.721	6.120	6.576	3.355
Skewness	-0.715	0.406	0.052	-0.432	-0.185
Kurtosis	1.896	2.090	1.406	1.995	1.764

Source: Author's Calculations

Lastly, India recorded the lowest DRI score compared to all countries. It maintained an average of 50.79 per cent which is a few points shy away to an average of 60.00 per cent. Like China though, its DRI remained very unpredictable over the 10-year period. This unpredictability is not surprising because it is reflective of the trend that was presented by Baller *et al.* (2016) in Figure 2 above.

Overall, these results are squarely in line with the 2016 NRI where India ranked the lowest amongst the BRICS countries (World Economic Forum, 2016a). Similar to the 2016 Network Readiness Index results, China and Russia have maintained higher levels of digital readiness followed by South Africa and Brazil and lastly India.

4.1.2 *Descriptive Statistics: Equity Returns*

Table 2 below shows that growth in equity returns in the banking industry have generally outperformed all other industries across all countries with real estate in Russia being the exception[1]. Volatility of equity returns was very high in Brazilian, South African and Russian banking industry whereas Chinese and Indian

[1] *Equity Returns data completeness for Russia's insurance and real estate is very low which could potentially impact inferences; however, its ROE data completeness is much better for later analysis in Regression Analysis section*

banking industry recorded a state of tranquillity over the 10-year period under review.

Equity returns growth in insurance firms generally followed banking across countries with pockets of high volatility in Chinese and Brazilian firms whereas volatility in Russian and South African insurance firms came out moderate in relative terms.

Table 2: Equity Returns Descriptive Statistics

COUNTRY	BRAZIL				RUSSIA			
INDUSTRY	BANKS	INSURANCE	INVESTMENTS	REAL ESTATE	BANKS	INSURANCE	INVESTMENTS	REAL ESTATE
Mean	11875.290	2742.062	1918.629	978.730	2343.914	43.229	375.972	2214152.000
Standard Deviation	22946.360	5522.546	5679.837	1249.946	10585.140	146.340	941.704	6274619.000
Skewness	1.902	2.433	3.757	1.851	5.996	4.574	3.192	3.463
Kurtosis	5.414	8.026	17.155	6.371	40.519	26.840	13.132	15.351
Obs	169	70	249	270	376	75	116	158
COUNTRY	INDIA				CHINA			
INDUSTRY	BANKS	INSURANCE	INVESTMENTS	REAL ESTATE	BANKS	INSURANCE	INVESTMENTS	REAL ESTATE
Mean	5193.349	2292.082	166.527	146.748	20516.280	10657.22	4322.375	1723.798
Standard Deviation	10766.340	3717.828	1526.866	672.171	49484.040	14007.68	6693.199	2566.367
Skewness	3.736	1.946	20.8733	10.247	4.123	1.446450	2.734	5.044
Kurtosis	21.574	6.028	532.710	136.514	20.673	3.965819	13.870	40.000
Obs	349	80	5340	1286	277	60	528	1198

COUNTRY	SOUTH AFRICA			
INDUSTRY	BANKS	INSURANCE	INVESTMENTS	REAL ESTATE
Mean	10102.080	1760.447	858.896	808.072
Standard Deviation	7434.258	1902.278	2319.135	1257.580
Skewness	0.561	1.006	4.005	2.248
Kurtosis	2.489	3.311	19.811	7.517
Obs	75	80	254	250

Source: Author's Calculations

Equity returns in investment firms were higher in China and Brazil and relatively low in Russia, India and South Africa. Similarly, the volatility of equity returns in China and Brazil were higher than in Russia, India and South Africa in relative terms. Real estate equity returns were generally lower across countries with the exception of China which recorded the highest average for the period under study.

4.1.3 *Trend Analysis: Digital Readiness*

Although Russia has maintained a higher mean of digital readiness over the 10-year period, China has shown remarkable improvement from year 2010 to 2019 as illustrated in Figure 3 below.

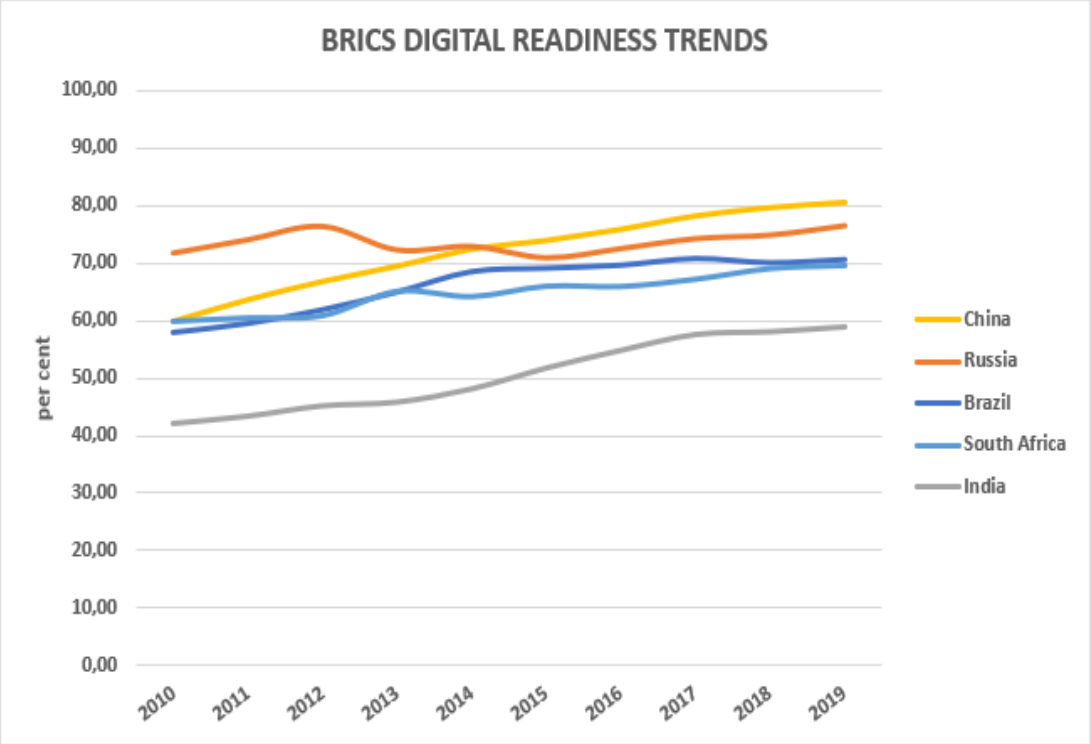


Figure 3: 2010 - 2019 Digital Readiness Trends
Source: Author's illustration

On the other hand, Brazil has experienced stagnation from year 2014 to 2018 while South Africa played catch up with Brazil by year 2019. Like China, although showing the lower mean score for digital readiness, India has shown remarkable growth in digital readiness from year 2010 where digital readiness was just shy away from 40.00 per cent and grew to just below 60.00 per cent by year 2019. This growth trend is expected to continue and possibly surpass countries such as Brazil and South Africa whose digital readiness growth has been gradually stagnating between year 2014 and 2017.

Looking at the digital readiness sub-indexes trends in Figure 4 below, enabling infrastructure has consistently and generally outperformed other indexes throughout the 10-year period. China's recent improvements in DRI was as a result of a consistent improvement in affordability indicator. Generally, affordability has improved in the last 10 years except for Russia which shows a drop between 2013 and 2017.

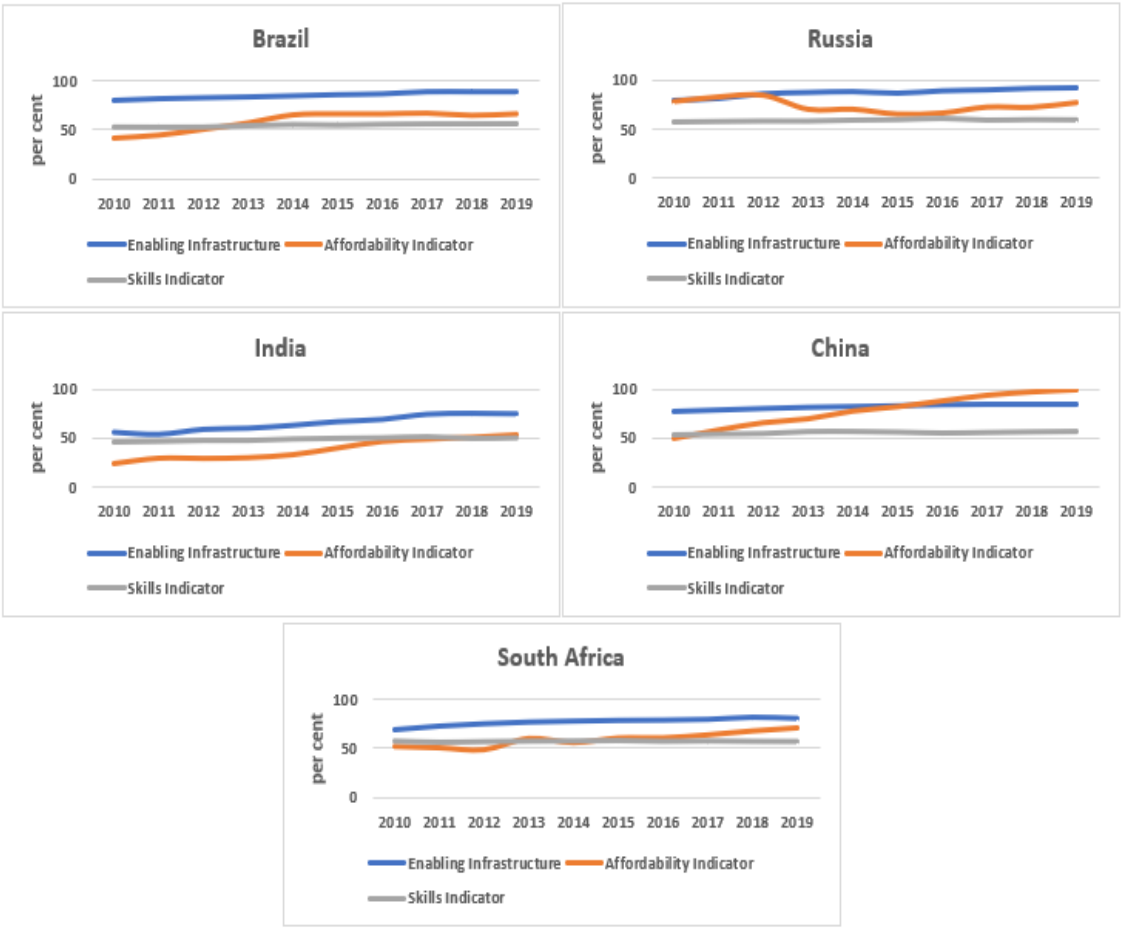


Figure 4: 2010 - 2019 Digital Readiness Sub-Index Trends
Source: Author's illustration

Skill levels have remained flat across all countries where in certain cases such as India and South Africa skills improvement growth started either higher or at par with affordability, but affordability eventually grew fast than skills.

4.1.4 *Trend Analysis: Equity Returns*

Figure 5 below shows higher equity returns trends in banking across all countries which is supported by higher average equity returns that are reported under the descriptive statistics above. India and China have recorded an upward trend in banking equity returns since 2010 while South African banking equity returns remained relatively stable. Brazil and Russia equity returns trends started off higher in 2010 and dropped to lowest levels in 2015 before taking a consistent upward trend until 2019. This trend is reflective of the findings by Moyo *et al.* (2018) who ascribed poor financial growth in Brazil to political upheavals between

2013 and 2015 as well as Ono (2017) who observed an unstable financial situation in Russia between 2012 and 2015.



Figure 5: Average Equity Return Trends
Source: Author's illustration

Insurance equity returns growth rates remained steady across all countries except for India which recorded an upward swing from 2017 onwards. Equally, investments and real estate equity returns remain subdued throughout the 10-year period when compared to other industries with the exception of Russian real estate equity returns whose trend showed an extremely erratic trend throughout the 10-year period.

Below analysis seeks to ascertain whether correlation reported above is supported by causality between digital readiness and equity returns.

4.2 CORRELATION AND CAUSALITY ANALYSIS

Correlation analysis below provides a view on the degree of association between digital readiness and equity returns. This data exploratory analysis attempts to answer questions on whether or not the relationship between digital readiness and equity returns is positive or negative. Causality analysis is an attempt to ascertain whether digital readiness does cause equity returns or not and vice versa.

4.2.1 *Correlation Analysis: Digital Readiness and Equity Returns*

Table 3 below shows an overwhelming view towards a positive relationship between digital readiness and equity returns. A few pockets of a negative relationship between digital readiness and equity returns are dominant for Brazil across all industries and predominantly for real estate industry in Brazil, Russia and India.

Table 3: Correlations Analysis: Digital Readiness and Equity Returns

INDUSTRY	BRAZIL	RUSSIA	INDIA	CHINA	SOUTH AFRICA
BANKS	-0.052	0.048	0.128	0.086	0.035
INSURANCE	0.214	0.020	0.550	0.175	0.042
INVESTEMENTS	-0.028	0.039	0.046	0.268	0.083
REAL ESTATE	-0.206	-0.031	-0.016	0.172	0.143

Source: Author's Calculations

China and South Africa are the only two countries amongst the BRICS countries that are showing a consistent positive relationship between digital readiness and equity returns across all industries. A positive correlation relationship between digital readiness and equity returns suggest that as digital readiness improves, equity returns improves as well and vice versa. On the contrary, a negative relationship between digital readiness and equity returns suggest that as digital readiness improves, equity returns deteriorates and the opposite is true. The

observations above are in line to the findings by Armstrong (2020) who cited a questionable correlation between digital readiness and economic growth.

Since correlation does not always imply causality, and, to prove or disprove direct preliminary findings above, analysis below is expected to provide the required confirmation on causality between digital readiness and equity returns.

4.2.2 *Causality Analysis: Digital Readiness and Equity Returns*

One of the preconditions in estimating a time series model is to ensure that the series are stationary in order to avoid spurious regressions (Jankee,2006; Boulila and Trabelsi, 2004). If the series are not stationary, the outcomes from the regressions cannot be relied upon for policy and/or strategy decisions as the outcomes would be unreliable.

Results in Table 4 below are supported by the precondition tests in Appendix E, the null hypothesis that data series is non-stationary is generally rejected based on p-values. The second difference estimation proves that equity returns and digital readiness series are both stationary which means that the causality test outcomes can be relied upon for policy and/or strategy decisions.

Furthermore, in most time series estimations such as causality tests, the dependent variable response to the explanatory variable happens with a lapse in time called a lag, which means that the financial performance may not respond to changes in digital readiness almost immediately. According to Lopez and Weber (2017), the optimal lag is chosen based on the lowest information criteria as illustrated in Appendix F because the choice of lags could have an impact on the test outcomes.

From Appendix F below, Brazilian and Russian industries show mixed lags where according to the AIC information criterion the optimal lag for Brazilian lags in banking and investment companies is 1-year while a 2-year optimal lag is preferred for insurance and real estate firms. On the other hand, a 2-year optimal lag is ideal for Russian banks and real estate firms while and a 1-year lag is optimal for insurance and investment firms in Russia.

A constant 2-year optimal lag for all industries in India, China and South Africa is confirmed by the AIC test except for South African Banks where a 1-year optimal lag was recommended. These unique optimal lags per country and industry combination were therefore taken into account in the causality estimation below.

From the causality estimation in Table 4 below, the null hypothesis that digital readiness does not Granger-Cause equity returns is rejected at 10 per cent significance level for Brazilian banks and real estate firms and at 20 per cent significance level for Brazilian investment firms. This means that digital readiness does Granger-Cause financial performance in Brazilian Banks, Real Estate and Investment firms and not in insurance firms.

In Russian firms, the null hypothesis that digital readiness does not Granger-Cause equity returns is rejected at 20 per cent significance level for insurance firms. This means that digital readiness does Granger-Cause financial performance in insurance firms and not in banking, real estate and investment firms.

The null hypothesis that digital readiness does not Granger-Cause equity returns is rejected at 1 per cent significance level for Indian Insurance firms and at 20 per cent significance level for real estate firms. This means that digital readiness does Granger-Cause financial performance in Indian insurance and real estate firms and not in banking and investment firms.

Table 4: Causality Analysis: Digital Readiness and Equity Returns

COUNTRY	HYPOTHESIS	BANKS		INSURANCE		INVESTMENTS		REAL ESTATE	
		STATISTIC	P-VALUE	STATISTIC	P-VALUE	STATISTIC	P-VALUE	STATISTIC	P-VALUE
BRAZIL	Digital Readiness does not Granger Cause Equity Returns	2.95804	0.0903*	0.34729	0.7080	1.86660	0.1732^	3.04931	0.0497*
	Equity Returns does not Granger Cause Digital Readiness	0.19775	0.6580	0.94493	0.3945	0.02769	0.8680	0.07572	0.9271
RUSSIA	Digital Readiness does not Granger Cause Equity Returns	1.41279	0.2451	2.02820	0.1593^	0.22068	0.6395	0.07004	0.9324
	Equity Returns does not Granger Cause Digital Readiness	1.17496	0.3103	0.67283	0.4151	0.24396	0.6224	0.40187	0.6700
INDIA	Digital Readiness does not Granger Cause Equity Returns	0.05591	0.9456	8.34885	0.0006***	0.06175	0.9401	1.62912	0.1966^
	Equity Returns does not Granger Cause Digital Readiness	1.23781	0.2916	0.14619	0.8643	0.34482	0.7084	1.07444	0.3419
CHINA	Digital Readiness does not Granger Cause Equity Returns	0.38936	0.6780	1.56070	0.2217	4.48838	0.0118*	10.9427	2.E-05
	Equity Returns does not Granger Cause Digital Readiness	0.31941	0.7269	0.00466	0.9953	2.28580	0.1030	4.92355	0.0075**
SOUTH AFRICA	Digital Readiness does not Granger Cause Equity Returns	2.95804	0.0903*	0.34729	0.7080	1.03132	0.3585	3.04931	0.0497*
	Equity Returns does not Granger Cause Digital Readiness	0.19775	0.6580	0.94493	0.3945	0.08280	0.9206	0.07572	0.9271

Source: Author's Calculations

Note: ^,,**,*** indicates significance at 20 per cent, 10 per cent, 5 per cent and 1 per cent levels respectively. Adopted the Stacked test (common coefficients) because the estimations were conducted for unbalanced industry data (common effects) and not Dumitrescu Hurlin test because it is ideal for balanced panel data.*

In Chinese firms, the null hypothesis that digital readiness does not Granger-Cause equity returns is rejected at 10 per cent significance level for investment firms. This means that digital readiness does Granger-Cause financial performance in investment firms and not in banking, real estate and insurance firms.

Lastly, the null hypothesis that digital readiness does not Granger-Cause equity returns is rejected at 10 per cent significance level for South African banking and real estate firms. This means that digital readiness does Granger-Cause financial performance in Banking and real estate firms and not in insurance and Investment firms.

4.2.3 *Summary Remarks on Causality Analysis*

The null hypothesis that equity returns does not Granger-Cause digital readiness is generally not rejected at all significance levels across countries and across industries except for a single anomaly in Chinese real estate firms where the null hypothesis that equity returns does not Granger-Cause digital readiness was rejected at 5 percent significance level. Although results across countries and industries are mixed, there is an overwhelming evidence of a one-directional causality from digital readiness to equity returns which supports the view that digital readiness is a potential driver of equity returns in financial firms across BRIC countries.

The regression analysis below is a deeper investigation on the significance and direction of impact between digital readiness sub-indexes and financial performance.

4.3 REGRESSION ANALYSIS

The below regression results are estimated using the GMM estimator where the appropriate model between random and fixed effects was chosen based on the Hausman test (see Petria *et al.*, 2015; Owoputi *et al.*, 2014). In addition, the Durbin Watson is also used to validate the robustness of the estimations. Adjusted R-Squared confirms a strong explanatory power of the digital readiness estimations based on its sub-indexes (see table 5 to Table 8) and not aggregate readiness estimations (see appendix 8). For this reason, the regression analysis below between digital readiness and financial performance is based on digital readiness sub-indexes (infrastructure readiness, internet affordability and skill levels independent variables).

4.3.1 *Banking Industry Comparative Analysis*

The results from Table 5 below shows that in Brazil, at 10 per cent significance level, a 1 per cent increase in affordability and skills result in USD 1 403 million increase in equity returns and USD 2 826 million decrease in equity returns respectively while the influence of infrastructure is insignificant. In Russia, at 10 per cent significance level, a 1 per cent increase in infrastructure, affordability and skills result in USD 5 940 million increase in equity returns, USD 837 million decrease in equity returns and in USD 2 017 million increase in equity returns, respectively.

In India, at 10 per cent significance level, a 1 per cent increase in infrastructure result in USD 439 million decrease in equity returns. At 5 per cent significance level, a 1 per cent increase in skills result in USD 2 339 million increase in equity returns while the influence of affordability is insignificant. China is an odd case where digital readiness does not seem to have a significant impact on equity returns although the coefficients for affordability and skills are positive.

Equity returns in South Africa respond to all categories of digital readiness although the influence of infrastructure is very weak. At 20 per cent significance level, a 1 per cent increase in infrastructure result in USD 687 million increase in equity returns. At 10 per cent significance level, a 1 per cent increase in affordability and skills result in USD 612 million decrease in equity returns and USD 3 104 million decrease in equity returns respectively.

Table 5 below provides a summary analysis of the above discussion.

Table 5: Banking Industry Comparative Analysis

	BRICS BANKING INDUSTRY COMPARATIVE ANALYSIS									
COUNTRY DEPENDENT VARIABLES	VARIABLE:	BRAZIL		RUSSIA		INDIA		CHINA		SOUTH AFRICA	
		Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE
	C	11360.560*** (6.411) [0.000]	8.775*** (8.223) [0.000]	2241.832*** (5.319) [0.000]	-2.945 (-0.928) [0.353]	5133.943*** (14.282) [0.000]	6.625*** (9.952) [0.000]	21199.270*** (8.869) [0.000]	14.439*** (40.495) [0.000]	11670.500*** (16.455) [0.000]	15.993*** (36.032) [0.000]
EXPLANATORY VARIABLES	Infrastructure	-1492.279 (-1.187) [0.237]	-3.090* (-2.275) [0.024]	5840.711^ (1.645) [0.102]	-24.034 (-0.985) [0.325]	-439.417* (-1.728) [0.085]	1.710** (3.177) [0.001]	-13008.900 (-1.011) [0.312]	-1.953 (-1.031) [0.303]	687.640^ (1.518) [0.136]	-0.502* (-2.196) [0.033]
	Affordability	1043.185* (2.013) [0.046]	0.761^ (1.387) [0.168]	837.996* (1.904) [0.053]	-3.902 (-1.245) [0.213]	-123.189 (-0.932) [0.352]	1.106** (3.093) [0.002]	596.834 (0.666) [0.505]	0.462** (2.920) [0.003]	-712.345* (-2.190) [0.034]	0.414* (2.318) [0.025]
	Skills	-2826.998* (-2.137) [0.034]	-1.546 (-0.658) [0.511]	2017.006* (2.413) [0.016]	4.991 (0.782) [0.434]	2339.449** (2.781) [0.005]	-5.863*** (-3.714) [0.000]	3271.643 (0.763) [0.446]	0.327 (0.477) [0.633]	3104.152* (1.853) [0.070]	-2.719* (-2.349) [0.023]
CONTROL VARIABLES	Unemployment	299.089 (0.299) [0.765]	-0.340 (-0.312) [0.755]	21762.930* (1.764) [0.078]	-93.917 (-1.081) [0.280]	1037.390 (1.109) [0.268]	-0.987 (-0.599) [0.549]	-1366.831 (-0.118) [0.905]	-2.266 (-1.311) [0.191]	-2816.055* (-2.248) [0.029]	1.876* (2.523) [0.015]
	Exchange Rates	-4978.599 (-0.978) [0.330]	7.864^ (1.353) [0.178]	-525.224* (-2.129) [0.034]	0.756 (0.435) [0.663]	13.308 (0.081) [0.935]	-1.005* (-2.233) [0.026]	15364.510 (0.596) [0.551]	6.944* (1.821) [0.070]	4006.490* (2.076) [0.043]	-3.054** (-2.732) [0.009]
	Interest Rates	-233.791 (-0.701) [0.484]	0.492 (1.167) [0.245]	-135.233 (-0.464) [0.642]	3.179* (1.685) [0.093]	180.419 (0.120) [0.904]	5.578* (2.056) [0.040]	-1682.989 (-0.274) [0.784]	-3.499*** (-3.774) [0.000]	-2654.648 (-1.174) [0.246]	-0.802 (-0.467) [0.642]
	Inflation Rates	875.047 (1.051) [0.295]	-0.337 (-0.313) [0.754]	1648.588^ (1.414) [0.158]	-7.077 (-0.923) [0.356]	743.133** (3.051) [0.002]	-1.280* (-2.575) [0.010]	2227.566 (0.698) [0.485]	0.225 (0.529) [0.597]	935.396^ (1.325) [0.191]	-0.448 (-0.941) [0.351]
	GDP Growth Rates	140.193 (0.186) [0.852]	2.195** (2.811) [0.005]	-836.3436 (-0.907) [0.364]	-1.240 (-0.193) [0.846]	-734.737 (-0.994) [0.320]	6.021*** (4.525) [0.000]	-7730.873 (-0.829) [0.407]	2.517^ (1.608) [0.109]	4779.706* (1.995) [0.052]	-4.015** (-3.229) [0.002]
MODEL STATISTICS	Adjusted R-Squared	0.694	0.537	0.394	0.231	0.652	0.273139	0.449	0.265	0.788	0.727
	Durbin-Watson Stat	1.468	1.554	1.335	1.710	1.112	1.371	0.774	0.902	1.000	1.609
	Hausman Test	[1.000]	[1.000]	[1.000]	[1.000]	[1.0000]	[1.000]	[1.000]	[1.000]	[0.000]	[0.000]
	Obs	135	135	300	300	279	279	221	221	59	59

*Note: ^, *, **, *** indicates significance at 20 per cent, 10 per cent, 5 per cent and 1 per cent levels respectively.*
Source: Author's Calculations

4.3.2 *Insurance Industry Comparative Analysis*

Similar to the Banking estimations above, equity returns estimations for the insurance industry show a much stronger explanatory power when compared to the ROE estimations which suggested that digital readiness impact on market based financial performance measures is more profound than its impact on accounting based financial performance measures.

Results from Table 6 below suggest that equity returns in Brazil and South Africa are not responsive to variations in digital readiness as none of the coefficients are significant and the direction of impact in the South African market is largely negative while that of Brazil is largely positive except for the impact of skills which has a negative coefficient. There is an irrefutably positive and significant impact of digital readiness in Russia and China while India exhibits a largely negative but significant impact of digital returns on the variations of equity returns.

In Russia, at 10 per cent significance level, a 1 per cent improvement in infrastructure and affordability result in a respective USD 7 000 million and USD 894 million increase in equity returns. At 5 per cent significance level, a 1 per cent improvement in skill levels give rise to USD 2 120 million increase in equity returns.

In contrast, for India, at 1 per cent significance level, a 1 per cent improvement in infrastructure and affordability result in a respective USD 1 069 million and USD 546 million decrease in equity returns. However, at 1 per cent significance level, a 1 per cent improvement in skill levels give rise to USD 3 750 million increase in equity returns.

China shows consistently positive and significant coefficients across all measures of digital readiness. At 1 percent significance level, a 1 per cent improvement in enabling infrastructure result to a USD 41 298 million improvement in equity returns. On affordability, at 1 per cent significance level, a 1 percent improvement give rise to a USD 4 275 million increase in equity returns. Lastly, at 5 per cent

significance level, a 1 per cent improvement is skill levels result in a USD 2 984 million increase in equity returns.

Table 6 below provides a summary analysis of the above discussion.

Table 6: Insurance Industry Comparative Analysis

	BRICS INSURANCE INDUSTRY COMPARATIVE ANALYSIS									
COUNTRY DEPENDENT VARIABLES	VARIABLE:	BRAZIL		RUSSIA		INDIA		CHINA		SOUTH AFRICA	
		Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE
	C	3647.538*** (7.979) [0.000]	30.533*** (7.125) [0.000]	2230.687*** (5.284) [0.000]	-2.962 (-0.861) [0.389]	3147.493*** (9.861) [0.000]	14.817*** (7.412) [0.000]	23769.220*** (8.583) [0.000]	9.632* (1.813) [0.078]	1791.282*** (23.441) [0.000]	20.588*** (14.231) [0.000]
EXPLANATORY VARIABLES	Infrastructure	233.834 (0.388) [0.699]	2.456 (0.435) [0.665]	7000.816* (2.448) [0.015]	-22.313 (-1.009) [0.313]	-1069.299*** (-5.341) [0.000]	3.191* (2.545) [0.014]	41298.010*** (4.300) [0.000]	11.112 (0.603) [0.550]	-93.977 (-0.388) [0.699]	10.851* (2.367) [0.021]
	Affordability	219.803 (0.814) [0.420]	4.932* (1.949) [0.058]	894.216* (2.214) [0.027]	-3.819 (-1.220) [0.223]	-546.967*** (-4.436) [0.000]	0.833 (1.078) [0.285]	4275.468*** (4.540) [0.000]	0.797 (0.441) [0.661]	-11.754 (-0.714) [0.478]	0.625* (2.008) [0.050]
	Skills	-1097.507 (-0.959) [0.342]	-26.185* (-2.441) [0.018]	2120.300** (2.661) [0.008]	5.144 (0.797) [0.425]	3750.367*** (5.274) [0.000]	-11.727* (-2.633) [0.011]	2984.252** (3.034) [0.004]	0.265 (0.140) [0.888]	-119.796 (-0.610) [0.544]	1.870 (0.503) [0.617]
CONTROL VARIABLES	Unemployment	-70.564 (-0.114) [0.909]	12.948* (2.238) [0.030]	25156.420* (2.427) [0.015]	-88.884 (-1.101) [0.271]	2435.189** (3.165) [0.002]	-9.099* (-1.888) [0.064]	8975.759*** (5.018) [0.000]	2.905 (0.847) [0.402]	-161.393 (-0.376) [0.708]	12.622^ (1.555) [0.126]
	Exchange Rates	-4029.788^ (-1.600) [0.116]	-63.429* (-2.687) [0.010]	--577.361** (-2.639) [0.008]	0.678 (0.408) [0.682]	685.875*** (4.385) [0.000]	-2.829** (-2.888) [0.005]	-41423.620*** (-4.626) [0.000]	-14.379 (-0.837) [0.408]	43.596 (0.624) [0.535]	-0.549 (-0.415) [0.679]
	Interest Rates	-22.480 (-0.184) [0.854]	-2.292* (-2.010) [0.050]	6.749 (0.025) [0.979]	3.389^ (1.616) [0.107]	3913.382*** (5.054) [0.000]	5.412 (1.116) [0.269]	-9138.275** (-3.440) [0,001]	-1.108 (-0.217) [0.829]	-74.136 (-0.233) [0.816]	23.534*** (3.915) [0.000]
	Inflation Rates	676.686 (1.276) [0.208]	11.246* (2.263) [0.028]	2132.232* (2.525) [0.012]	-6.360 (-0.992) [0.321]	696.832*** (4.472) [0.000]	-0.220 (-0.225) [0.822]	2369.034** (3.501) [0.001]	0.507 (0.391) [0.697]	-48.923 (-0.444) [0.658]	-6.646** (-3.191) [0.002]
MODEL STATISTICS	Adjusted R-Squared	0.742376	0.433	0.394	0.234	0.324	0.597	0.944	0.366	0.912	0.612
	Durbin-Watson Stat	1.623	0.765	1.337	1.709	1.071	1.204	2.660	1.695	1.762	1.660
	Hausman Test	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
	Obs	56	56	300	300	64	64	48	48	64	64

*Note: ^, *, **, *** indicates significance at 20 per cent, 10 per cent, 5 per cent and 1 per cent levels respectively.*
Source: Author's Calculations

4.3.3 *Investments Industry Comparative Analysis*

The impact of digital readiness on equity returns in the investment industry is largely negative with pockets of positive coefficients across countries. In addition, the model explanatory power for equity returns estimations does not seem to significantly differ from the ROE estimations which potentially means that the impact of digital readiness measures on market based financial performance measures in not that different to the digital readiness impact on accounting-based measures of financial performance.

Table 7 below shows that Brazil's digital readiness has mixed effects to variations in equity returns. For example, the impact of infrastructure is totally mute while at 10 per cent significance level a 1 per cent improvement in affordability give rise to USD 365 million increase in equity returns yet at 1 per cent significance level, a 1 per cent improvement in skills result in USD 1 236 million decrease in equity returns.

In contrast, Russia shows a consistent negative reaction across digital readiness measures. At 20 per cent significance level, a 1 per cent improvement in infrastructure is expected to result in USD 763 million drop in equity returns. While affordability is irresponsive, at 20 per cent significance levels a 1 per cent improvement in skills is expected to result in a USD 224 million drop in equity returns.

Similar to Russia, India results are also showing mixed reactions of digital readiness on equity returns. At 10 per cent significance level, a 1 per cent improvement in infrastructure result to a USD 29 million drop in equity returns yet the impact of affordability remains silent. In contrast, at 5 per cent significance level, a 1 per cent improvement in skill levels result to a USD 114 million increase in equity returns.

Similar to insurance results, China shows stronger levels of significance across all measures of digital readiness although the impact of infrastructure is negative. At 1 percent significance level, a 1 per cent improvement in infrastructure leads to a USD 10 396 million decrease in equity results. However, the impact of both

affordability and skills is positive. At 1 per cent significance levels, a 1 per cent improvement in affordability and skills lead to a respective USD 578 million and USD 2 448 million increase in equity returns.

Surprisingly, the impact of digital readiness in the South African market is totally mute. Although there is no evidence of statistical significance, the direction of response between digital readiness and equity returns is predominantly negative.

Table 7 below provides a summary analysis of the above discussion.

Table 7: Investment Industry Comparative Analysis

	BRICS INVESTMENTS INDUSTRY COMPARATIVE ANALYSIS									
COUNTRY DEPENDENT VARIABLES	VARIABLE:	BRAZIL		RUSSIA		INDIA		CHINA		SOUTH AFRICA	
		Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE
	C	2007.185*** (5.979) [0.000]	-19.842** (-3.211) [0.001]	351.637*** (79.128) [0.000]	3.926*** (3.596) [0.000]	169.636*** (9.692) [0.000]	2.138*** (10.897) [0.000]	4404.836*** (18.597) [0.000]	5.494*** (6.395) [0.000]	846.894*** (7.149) [0.000]	9.704*** (6.587) [0.000]
EXPLANATORY VARIABLES	Infrastructure	-103.105 (-0.357) [0.721]	-0.723 (-0.172) [0.863]	-763.054^ (-1.357) [0.178]	-0.122 (-0.015) [0.987]	-29.740* (-2.082) [0.037]	0.297* (2.031) [0.042]	-10396.300*** (-7.702) [0.000]	-10.978* (-2.211) [0.027]	-87.220 (-1.246) [0.214]	0.905 (1.178) [0.240]
	Affordability	363.513* (2.125) [0.035]	6.338* (1.986) [0.048]	-53.087 (-0.780) [0.437]	0.139 (0.149) [0.881]	-10.393 (-1.250) [0.211]	-0.023 (-0.272) [0.785]	578.314*** (6.558) [0.000]	0.705* (2.253) [0.024]	38.405 (0.967) [0.334]	1.114* (2.301) [0.022]
	Skills	-1236.318* (-1.706) [0.089]	-21.440^ (-1.589) [0.113]	-224.574^ (-1.397) [0.166]	0.474 (0.222) [0.824]	114.065** (2.837) [0.004]	-0.751* (-1.664) [0.096]	2448.316*** (5.177) [0.000]	1.893 (1.166) [0.244]	-204.219 (-0.470) [0.638]	-13.112** (-3.079) [0.002]
CONTROL VARIABLES	Unemployment	373.399 (0.856) [0.392]	6.660 (0.823) [0.411]	-2381.402 (-1.238) [0.219]	1.158 (0.043) [0.965]	72.568* (2.090) [0.036]	-0.610 (-1.281) [0.200]	-7898.961*** (-5.824) [0.000]	-10.680* (-2.278) [0.023]	267.382^ (1.598) [0.111]	0.906 (0.412) [0.680]
	Exchange Rates	-2407.770 (-1.233) [0.219]	-28.698 (-0.848) [0.397]	48.985 (1.167) [0.246]	0.015 (0.027) [0.978]	9.239 (0.816) [0.414]	-0.099 (-0.941) [0.346]	18234.470*** (6.713) [0.000]	27.676** (3.046) [0.002]	-285.316 (-1.093) [0.275]	-6.904* (-2.378) [0.018]
	Interest Rates	-100.905 (-0.996) [0.320]	-0.917 (-0.494) [0.621]	-145.289* (-2.341) [0.022]	0.431 (0.556) [0.579]	-7.036 (-0.103) [0.917]	2.524** (3.127) [0.001]	-2731.953*** (-4.672) [0.000]	-6.118** (-3.193) [0.001]	-243.844 (-0.553) [0.580]	24.992*** (3.487) [0.000]
	Inflation Rates	535.894^ (1.526) [0.128]	9.271^ (1.490) [0.138]	-246.445^ (-1.304) [0.196]	-0.394 (-0.154) [0.877]	28.675* (2.448) [0.014]	0.043 (0.333) [0.738]	2065.203*** (7.078) [0.000]	3.302** (3.225) [0.001]	-56.565 (-0.439) [0.660]	-6.466** (-3.011) [0.003]
	GDP Growth Rates	57.606 (0.240) [0.810]	4.511 (1.050) [0.295]	-326.737* (-1.840) [0.069]	-1.218 (-0.530) [0.597]	-33.150^ (-1.395) [0.162]	0.637* (1.786) [0.074]	-7498.070*** (-6.198) [0.000]	-6.886^ (-1.603) [0.109]	-411.285^ (-1.423) [0.156]	-4.480^ (-1.350) [0.178]
MODEL STATISTICS	Adjusted R-Squared	0.584	0.595	0.099	0.060	0.368	0.353	0.423	0.258	0.401	0.433
	Durbin-Watson Stat	1.389	1.410	1.212	1.429	0.727	1.085	1.409	1.745	0.757	1.775
	Hausman Test	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]
	Obs	199	199	92	92	4272	4272	422	422	202	202

*Note: ^, *, **, *** indicates significance at 20 per cent, 10 per cent, 5 per cent and 1 per cent levels respectively.*
Source: Author's Calculations

4.3.4 *Real Estate Industry Comparative Analysis*

Real estate findings in Table 8 below also carry a mixed message on the relationship between digital readiness and market-based measures of financial performance. Results from Russia show abnormally large coefficients due to the influence of outliers and data completeness issues which impedes making sound conclusions based purely on these results.

On the other hand, Brazil is showing consistent positive coefficients across all measures of digital readiness although the impact of skill levels is not conclusive. However, at 20 per cent significance level, a 1 per cent improvement in infrastructure enablement result in USD 79 million increase in equity returns. In India, at 10 per cent significance levels, a 1 per cent improvement in infrastructure and affordability result in a respective USD 22 million and USD 11 million increase in equity returns.

Similar to insurance and investment industries, Chinese real estate equity returns are significantly responsive to variations is digital readiness measures. At 1 per cent significance level, a 1 per cent improvement in infrastructure enablement result to a USD 2 280 million decrease in equity returns. On the contrary, at 1 per cent significance level, a 1 per cent improvement in affordability of digital services enable a USD 218 million increase in equity returns. At 10 per cent significance level, a 1 per cent improvement in skill levels creates a USD 204 million increase in equity returns.

In South Africa, all measures of digital readiness seem not to have an impact on market-based measures of financial performance except for infrastructure where at 10 percent significance level, a 1 per cent improvement in enabling infrastructure triggers a USD 227 million increase in equity returns.

Table 8 below provides a summary analysis of the above discussion.

Table 8: Real Estate Industry Comparative Analysis

COUNTRY DEPENDENT VARIABLES	BRICS REAL ESTATE INDUSTRY COMPARATIVE ANALYSIS									
	VARIABLE:	BRAZIL		RUSSIA		INDIA		CHINA		SOUTH AFRICA	
		Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE
	C	920.108*** (24.545) [0'000]	-25.167*** (-6.703) [0.000]	2012103.000*** (5.681) [0.000]	-22814.700 (-0.987) [0.325]	150.860*** (9.831) [0.000]	2.9602*** (3.877) [0.000]	1485.165*** (14.674) [0.000]	8.516*** (12.746) [0.000]	967.536*** (32.302) [0.000]	12.941*** (9.453) [0.000]
EXPLANATORY VARIABLES	Infrastructure	79.377^ (1.607) [0.109]	9.670* (1.955) [0.052]	-2319214.000 (-1.068) [0.287]	-228580.000* (-1.672) [0.097]	-22.730* (-2.001) [0.045]	0.465 (0.835) [0.403]	-2280.669*** (-4.986) [0.000]	0.419 (0.148) [0.882]	227.817* (2.400) [0.017]	10.593* (2.442) [0.015]
	Affordability	127.903*** (5.777) [0.000]	0.512 (0.231) [0.817]	-357019.9 (-1.162) [0.247]	-36440.430* (-1.890) [0.061]	-11.997* (-2.395) [0.016]	-0.282 (-1.105) [0.269]	218.833*** (4.762) [0.000]	-0.000 (-0.003) [0.997]	-4.099 (-0.635) [0.526]	0.967** (3.282) [0.001]
	Skills	3.340 (0.035) [0.971]	24.166* (2.571) [0.010]	-40424.140 (-0.069) [0.945]	-71837.400* (-1.938) [0.055]	71.087* (2.302) [0.021]	-2.750* (-1.914) [0.055]	204.708* (1.980) [0.048]	-0.109 (-0.165) [0.868]	67.921 (0.882) [0.378]	1.747 (0.497) [0.619]
CONTROL VARIABLES	Unemployment	136.095** (2.689) [0.007]	-0.435 (-0.086) [0.931]	-8212930.000 (-1.038) [0.301]	-788435.600^ (-1.587) [0.115]	34.245 (0.874) [0.382]	-3.310* (-1.696) [0.090]	74.749 (0.476) [0.634]	1.708^ (1.320) [0.187]	445.465** (2.652) [0.008]	13.663* (1.779) [0.076]
	Exchange Rates	269.340^ (1.304) [0.193]	59.170** (2.861) [0.004]	51408.680 (0.338) [0.735]	19471.730* (2.052) [0.042]	16.786* (2.322) [0.020]	0.384 (1.048) [0.294]	3500.384*** (4.284) [0.000]	-3.540 (-0.676) [0.499]	-18.045 (-0.659) [0.510]	-2.587* (-2.068) [0.040]
	Interest Rates	-23.748* (-2.380) [0.018]	0.596 (0.597) [0.551]	-56179.040 (-0.270) [0.787]	8499.231 (0.581) [0.562]	9.253 (0.235) [0.814]	1.214 (0.615) [0.538]	-67.950 (-0.359) [0.719]	0.822 (0.616) [0.537]	-286.192* (-2.300) [0.022]	25.425*** (4.470) [0.000]
	Inflation Rates	59.338^ (1.364) [0.174]	-4.791 (-1.100) [0.272]	-664639.300 (-1.071) [0.286]	-73239.270* (-1.866) [0.064]	-5.359 (-0.518) [0.604]	-1.357** (-2.684) [0.007]	198.721*** (3.692) [0.000]	-0.166 (-0.429) [0.667]	-22.069 (-0.511) [0.609]	-6.479** (-3.288) [0.001]
MODEL STATISTICS	Adjusted R-Squared	0.839	0.777	0.468	0.408	0.453	0.185	0.589	0.212	0.912	0.177
	Durbin-Watson Stat	1.085	1.467	1.402	1.172	1.066	1.449	2.054	1.303	1.021	0.864
	Hausman Test	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]
	Obs	216	216	126	126	1028	1028	958	958	200	200

*Note: ^, *, **, *** indicates significance at 20 per cent, 10 per cent, 5 per cent and 1 per cent levels respectively.*
Source: Author's Calculations

4.4 CONCLUSION

In summary, the above analysis confirms a general positive response of financial performance from banking and insurance firms due to variations in digital readiness. These positive effects are mainly driven by internet affordability and skill levels. In contrast, financial performance in investments and real estate firms generally responds negatively to variations in digital readiness. A comparative view across countries suggests that results from Russia and South Africa are generally inconclusive, while China shows a strong positive response followed by Brazil and lastly a general negative response from India.

Most importantly, using the Adjusted R-squared as a measure of explanatory power of the regression models, results across most countries and industries prove that the equity returns(market-based financial performance measure) regression model commands more explanatory power compared to ROE (accounting-based financial performance measure) regression analysis. This view supports the hypothesis that market-based measures of financial performance are more responsive to changes in digital readiness than accounting-based measures of financial performance.

CHAPTER 5. DISCUSSION AND KEY FINDINGS

This section is a country and industry comparative discussion on how digital readiness impact on financial performance varies across countries and industries. The section then concludes with a prognosis of whether or not FinTechs are already proving to be a threat to various sectors of the financial industry.

5.1 COUNTRY DISCUSSION

Table 9 below shows a generally positive and significant impact of digital readiness on financial performance of financial firms in BRICS countries. This positive and significant response of financial performance due to changes in digital readiness is very profound and visible in China and Brazil.

Other than banking, financial performance of financial firms responds positively to the changes in digital readiness mainly driven by affordability and skill levels. In particular, affordability and skill levels have a positive and significant impact on financial performance across insurance, investments and real estate companies. In contrast, infrastructure effects on financial performance are consistently negative across industries except for insurance where a positive impact is observed.

Although Cann (2016) suggested that infrastructure readiness is a key determinant for digital readiness, above evidence on infrastructure effects suggest otherwise. In line to the findings by Davidrajuh *et al*. (2008), these negative infrastructure effects on financial performance could be emanating from costly and unreliable electricity production especially in countries such as South Africa where load shedding has become a common phenomenon.

The positive and significant response from Brazil is mainly driven by the affordability effects. With the exception from the insurance industry, banking, investments and real estate equity returns respond positively and significant to

the changes in affordability. This positive response could be driven by a general upward trend in affordability scores from 2014 to 2019 whereas infrastructure and skills growth remained muted during the same period. This observation is confirmed by the causality analysis in Table 4 above. In addition, Wyckoff and Pilat (2017) argue that access and affordability of internet is very critical in maximising the benefits of digital technologies.

Although mostly insignificant, the overall response of equity returns due to digital readiness changes in India is generally negative. This negative response is informed by a consistent and generally negative response from infrastructure, affordability and skills. Perhaps this is a country that is already feeling the impact of a competitive FinTech environment where the changes in digital readiness is mainly benefiting the FinTech industry who are already taking away the market share of the mainstream financial industries. This observation is in line with assertions made by Citi (2016) and Accenture (2016) who argue that the growth of FinTech firms could potentially be a threat to financial returns in the financial industry. In fact, Ketterer *et al*. (2016) claim that FinTech firms are increasingly attacking insurers' core businesses and reshaping their revenue streams and profitability.

Generally, the response of equity returns due to changes in digital readiness from Russian and South African financial industry is largely inconclusive. These inconclusive results could potentially mean that the recent improvements and focus in digital readiness does not necessarily translate into financial performance in Russian and South African financial firms. These findings support arguments brought forward by Lambrechts and Sinha (2019) who claim that emerging market economies generally have burning priority problems to deal with such as bribery and corruption, starvation, wealth divide and unemployment before placing the necessary focus on digital readiness.

Table 9 below provides a summary analysis of the above discussion at a country level.

Table 9: Equity Returns Response to Variations in Digital Readiness

INDUSTRY	DIGITAL READINESS VARIABLE	RESPONSE OF EQUITY RETURNS					INDUSTRY VIEW		
		BRAZIL	RUSSIA	INDIA	CHINA	SOUTH AFRICA	DIRECTION	SIGNIFICANCE	
BANKS	Infrastructure	Negative	Positive^	Negative*	Negative	Positive^	Negative	-	Positive*
	Affordability	Positive*	Positive*	Negative	Positive	Negative*	Positive	*	
	Skills	Negative*	Positive*	Positive**	Positive	Positive**	Positive	**	
INSURANCE	Infrastructure	Positive	Positive*	Negative***	Positive***	Negative	Positive	**	Positive**
	Affordability	Positive	Positive*	Negative***	Positive***	Negative	Positive	**	
	Skills	Negative	Positive***	Positive***	Positive**	Negative	Positive	***	
INVESTMENTS	Infrastructure	Negative	Negative^	Negative*	Negative***	Negative	Negative	**	Negative
	Affordability	Positive*	Negative	Negative	Positive***	Positive	Positive	**	
	Skills	Negative*	Negative^	Positive**	Positive***	Negative	Negative	-	
REAL ESTATE	Infrastructure	Positive^	Negative	Negative*	Negative***	Positive*	Negative	**	Negative
	Affordability	Positive***	Negative	Negative*	Positive***	Negative	Negative	-	
	Skills	Positive	Negative	Positive*	Positive*	Positive	Positive	*	
DIGITAL READINESS VIEW	Infrastructure	Inconclusive	Inconclusive	Negative*	Negative**	Inconclusive	Inconclusive	-	Positive**
	Affordability	Positive**	Inconclusive	Negative*	Positive***	Negative	Positive	**	
	Skills	Negative	Inconclusive	Positive**	Positive**	Inconclusive	Positive	**	
COUNTRY VIEW	DIRECTION	Positive	Inconclusive	Negative	Positive	Inconclusive	Positive	**	
	SIGNIFICANCE	*	-	**	***	-			

*Note: ^, *, **, *** indicates significance at 20 per cent, 10 per cent, 5 per cent and 1 per cent levels respectively. Positive imply same direction movement between digital readiness and financial performance, negative imply an opposite direction movement between digital readiness and financial performance, while inconclusive imply an unclear direction.*
Source: Author's Compilation

5.2 INDUSTRY DISCUSSION

Table 9 above shows that banking equity returns generally respond positive and significantly so to the changes in digital readiness. The positive effects of digital readiness on financial performance are mainly driven by the positive and significant response from affordability and skill levels. Although there is a general negative response from infrastructure enablement on financial performance across countries, its effects on financial performance in banking are generally dwarfed by the overwhelming positive response from affordability and skill levels.

Like the observations made from the banking industry, the insurance industry shows an overwhelming evidence of a positive and significant relationship between digital readiness and equity returns across all BRICS countries with the exception of Brazil and South Africa. Furthermore, a comparative analysis between Indian and Chinese insurance results suggest that it is not the high DRI that result in a positive impact in financial performance, however, a general positive improvement in digital readiness has a corresponding positive impact in financial performance.

Contrary to the arguments put forward by Musabegović *et al*. (2019), Gomber *et al.* (2018) and Sen and Lam (2016) who claim that banking and insurance are now being disrupted by FinTechs, the above positive response does not give an impression of industries that are already impacted by new industry entrants. This view is further supported by Citi (2016) and Accenture (2016) who argue that banks and insurance companies appear to be ready to defend their dominance in the industry and maintain their relevance in the market. In fact, these authors claim that banks and insurance companies are still able to generate higher return on equity and are able to strengthen their share price/returns.

The regression analysis results from real estate firms are a typical case of proving that correlation does not always imply causality because the direction and significance of the coefficients from the regression analysis are in contradiction with an expectation of a positive relationship as reported in the correlation

analysis in Table 4 above. This view is also supported by the causality analysis in Table 4 above where there was no evidence of causality reported between digital readiness and equity returns, except from Brazilian and South African firms.

The general negative and insignificant response of equity returns from investment firms because of changes in digital readiness is mainly as a result of infrastructure and affordability response. These results suggest that the general improvement in infrastructure and affordability of digital platforms has little influence on financial performance of real estate firms.

In line with the arguments put forward by Musabegović *et al*. (2019), Gomber *et al.* (2018) and Sen and Lam (2016) who claim that financial firms are now being disrupted by FinTechs, the above negative response of digital readiness on financial performance does give the impression that real estate and investment firms are already starting to feel the impact of competition from the new industry entrants such as FinTechs. Similarly, Jagtiani and Lemieux (2017) observed that increased competition that comes with new industry players such as FinTech companies has the potential to erode sources of revenue for incumbent firms.

5.3 Are FinTechs really a serious threat?

Financial performance in banking and insurance firms generally respond positively to variations in digital readiness which could be an indication that competition from FinTech firms has not had a negative impact on financial performance in these industries. Although FinTech firms are increasingly attacking banks' and insurers' core businesses and reshaping these industries as claimed by Ketterer et al., (2016), the actual financial impact as reflected by the response in equity returns is inconsequential to substantiate a claim that FinTechs are a serious threat in current banking and insurance traditional revenues. In fact, Citi (2016) claim that FinTech disruption will initially eat industry growth by taking new segments and products before ultimately turning on traditional revenues.

On the other hand, financial performance in investments and real estate firms generally respond negatively to variations in digital readiness which could be an indication that competition from FinTech firms is already negatively impacting financial performance in these industries. Furthermore, Citi (2016) and Accenture (2016) also claim that FinTech firms are potentially becoming a threat to incumbent financial firms. This view suggests that financial performance in investments and real estate firms is easily disrupted by FinTech firms who are capable of easily and conveniently accelerating the provision and use of financial technology-based solutions.

5.4 SUMMARY

In summary, financial performance in banking and insurance industries across BRICS countries generally respond positive to the variations in digital readiness. This positive impact is generally driven by the improvement in internet affordability and skill levels. These findings are in line with Wyckoff and Pilat (2017) who found that access to internet is very critical in maximising the benefits of digital technologies while skills and education are key determinants on how digital technologies are used. In contrast financial performance in investments and real estate industries across BRICS countries generally respond negatively to the variations in digital readiness.

These results could suggest that financial performance in banking and insurance industries is not yet threatened by FinTechs and the opposite is true for investments and real estate financial performance.

CHAPTER 6. CONCLUSION AND RECOMMENDATIONS

This section concludes the study by providing a structured summary of the main findings, policy and strategy implications, limitations of the study as well as the considerations for future research.

6.1 Digital Readiness and financial performance dynamics

Other than the infrastructure effects whose impact on financial performance is not as clear, other digital readiness sub-indexes have a generally positive impact on financial performance. These positive gains are clearly visible from affordability and skills sub-indexes. Where there is an impact of digital readiness on financial performance, although not necessarily true across industries and across countries, a consistently positive and significant trend is observed.

Based on the above observations, it can be concluded that digital readiness generally has a positive and significant effect on financial performance.

6.1.1 *Infrastructure readiness and financial performance dynamics*

The impact of infrastructure across the BRICS countries and across industries is generally inconclusive, which means that there is a fair balance of a negative and positive response from infrastructure readiness to financial performance at industry level across most countries. Inconclusive results of the impact of infrastructure readiness on financial performance means that the relationship between infrastructure and financial performance is not clear, and therefore inconclusive.

6.1.2 *Internet affordability and financial performance dynamics*

There is a general positive transmission of internet affordability effects to variations in financial performance of financial firms. These positive effects are mainly evident in banking, insurance and investment firms with the exception of

real estate companies. The country view confirms that affordability has a positive and significant impact predominantly on Brazilian and Chinese firms.

It can therefore be inferred that the constant improvement in internet affordability trends in Brazil and China over the 10-year period under study has had a significant and positive impact on the financial performance of financial firms.

6.1.3 *Skills and education levels and financial performance dynamics*

Like internet affordability, there is a generally positive and significant response from banking, insurance and real estate financial performance as a result of variations in digital readiness through skills. At a country level, this generally positive feedback from skills on financial performance in the financial industry is clearly visible from India and China.

6.1.4 *Market-based vis-a-vis accounting-based financial measures*

The explanatory power of digital readiness on the variation of equity returns is more profound from the equity returns specification as compared to how digital readiness influences financial performance based on ROE specification. This view is common across all BRICS countries. The higher adjusted R-Squared from the equity returns estimation vis-à-vis the adjusted R-Squared from the ROE estimation is an indication that digital readiness has stronger explanatory power in explaining the variations of market-based financial performance measures compared to the digital readiness explanatory power for the variations in accounting based financial performance measures.

6.2 SUMMARY OF KEY FINDINGS

Key findings on empirical results and discussion on the impact of digital readiness on financial performance in financial industry are summarised as follows:

[1] Unlike previous studies that only tracked digital readiness of countries based on just a year worth of data, this study successfully applied the

longitudinal research design over a 10-year period to capture the long-run effects of digital readiness on financial performance in the financial industry. In addition, the successful application of the extend APT demonstrate that theories which were developed before the 4IR era are still relevant, however, their applicability may now need to incorporate new thinking in line with 4IR developments. This novel application of the longitudinal research design as well as the theoretical extension of a digital readiness and financial performance enquiry is truly revolutionary.

[2] The current state of infrastructure readiness is not a key determinant of financial performance in the financial industry across BRICS countries. This could suggest that the current levels of access to electricity, mobile network coverage and internet access in BRICS countries may not be at the right levels to have a positive and significant impact on financial performance in financial firms.

[3] There is a generally positive transmission of internet affordability effects to variations in financial performance of banking and insurance firms which could suggest that as more people afford access and usage of telecommunications services, the more they demand the supply and consumption of financial services.

[4] There is also a generally positive and significant response on banking and insurance financial performance because of variations in digital readiness through skills which suggest that improvement in education and training does induce demand, supply and consumption of financial services.

[5] Market-based financial performance measures respond better to variations in digital readiness when compared to accounting-based measures of financial performance. This could suggest a possible loss of pertinent information due to aggregation of accounting measures of financial performance.

6.3 POLICY AND STRATEGY IMPLICATIONS

Proposed polices include cost effective, reliable and uninterrupted power supply as well as building of credible and reliable data repository that track progress on digital readiness trends in order to take proactive remedial action should the trends show a deteriorating outlook. In addition, governments can offer subsidies and tax relief programmes to internet providers in order to encourage competitive and affordable internet prices. Corporate strategies that support and fund digital education and skills reform programmes from as early as the foundational phase up to tertiary level could go a long way in driving desired economic, societal and financial outcomes.

6.3.1 *Policy Implications*

Evidence of a positive impact from a constant improvement in digital readiness, in particular, China and India trends in Figure 2 and resultant effects in tables 5 to 8 above suggest that countries should now start putting similar focussed attention in monitoring and improving digital readiness in the same way they do in monitoring and improving macro-economic and social welfare indicators (Lambrechts and Sinha,2019). This is because digital readiness seem not to have an impact on financial performance in the financial industry only but has potential to impact other industries as well as the economy and society at large.

To achieve this, governments could possibly put constant and focussed attention on digital readiness by firstly building credible databases of digital readiness measures for monitoring and then create favourable environments that will ensure a constant and continuous improvement in digital readiness such as ensuring uninterrupted supply of electricity, affordable internet provision as well as building requisite digital skills.

Uninterrupted supply of electricity, affordable internet provision as well as improving digital skills could possibly result in improved financial performance of firms and thus have positive impact on the economy as a whole, which becomes a virtuous circle overtime. In line with the above recommendations and in an

attempt to contain power outages, the South African government recently unveiled eight additional independent power-supply bidders who will boost the national electricity producing capacity and induce competitive rates which eventually makes electricity more accessible and affordable to many (see Khumalo, 2021)

This attempt is supported by Davidrajuh *et al*., (2008) who categorically state that in order to achieve the required benefits from digital readiness, the cost of electricity power generation and distribution should be within the price range that users can afford. These authors further argue that power generation should be reliable and available to be used as and when required. Countries can achieve cost effective, reliable and uninterrupted power supply as well as affordable internet if governments provide subsidies or tax relief to electricity and internet producers in order to encourage the desired outcomes (Wyckoff and Pilat, 2017).

6.3.2 *Strategy Implications*

Skills improvement have shown a consistent positive and significant impact on the variation of financial performance across BRICS countries which calls for targeted focus in driving strategies that will maximise these benefits. In as much as it would appear that the immediate impact of skills is on financial performance of firms, there could be a potential feedback loop that may give rise to societal outcomes such as high literacy levels. This is because as organisations realise that an educated workforce has potential to impact financial performance positively, they are likely to invest in the educational aspirations of their employees thus ultimately contributing towards a literate society (Ketterer *et al*., 2016).

In addition, corporates can influence, lobby and support education reform policies at grassroots to ensure a consistent ingestion of literate labour force into the labour market as a way of ensuring consistent financial performance. This will in turn inform corporate employment strategies for the organisations that are deeply invested in educating the young generation and consequently making them employees of choice as soon as they finish their studies. As supported by

Westerman, Bonnet and McAfee (2014), building the necessary digital foundational skills is fundamental in shaping the current and future business landscape. In fact, Citi (2016), support the that skills may have a positive impact on financial performance of organisations.

Accordingly, South Africa recently released a draft paper for public comment on the country's digital readiness for 4IR where investment in human development and digital skills seem to be taking the centre stage in order to build the pipeline of future talent for a dynamic and increasing digitalised environment (see National Planning Commission, 2020)

Although Indian and Chinese skills trends remained subdued over the 10-year period compared to infrastructure trends, its impact on financial performance is consistently positive and significant. It can therefore be inferred that it is not necessarily high DRI scores that have an impact on financial performance but the incremental improvement in DRI scores. Invariably, this observation demands that government authorities and industry captains should put their effort not necessarily to get high scores of digital readiness but rather to improve those digital readiness sub-indexes that make a significant difference in societal, financial and economic outcomes.

6.4 LIMITATIONS OF THE STUDY

The lack of central and single repository of digital readiness data in general means that data must be extracted from different data sources where criteria for sourcing, defining, calculation and storing of such data may differ across sources. Secondly, completeness of equity returns data in certain countries such as Russia means that the data analysis specific to such countries should be interpreted with this limitation in mind.

Lastly, the applicability of the NRI framework has generally been ideal for a single period analysis because certain variables are sourced through surveys. Survey data outcomes are not necessarily stored in publicly available data sources and therefore where a historical longitudinal analysis is required, availability, reliability

and credibility of data becomes an issue. It is for this reason that this study only adapted the digital readiness components of the NRI framework because this data is in public domains and those data sources are widely used in academia and industry research endeavours.

6.5 FUTURE RESEARCH

Future research can expand the scope of study and include granular analysis of sub-indexes in order to drill down to the details of the sub-drivers of digital readiness. The insignificant infrastructure sub-index of digital readiness can be reconstructed to include other sub-variables that can be tested for significance.

In addition, it will be interesting to observe how digital readiness factors affect financial performance based on high frequency data, for example, instead of an analysis that is based on yearly data, monthly and daily data could possibly give deeper insights. Instead of limiting the study only on the impact of digital readiness, future research can explore the impact of other dimensions of NRI such as environment and usage of digital services.

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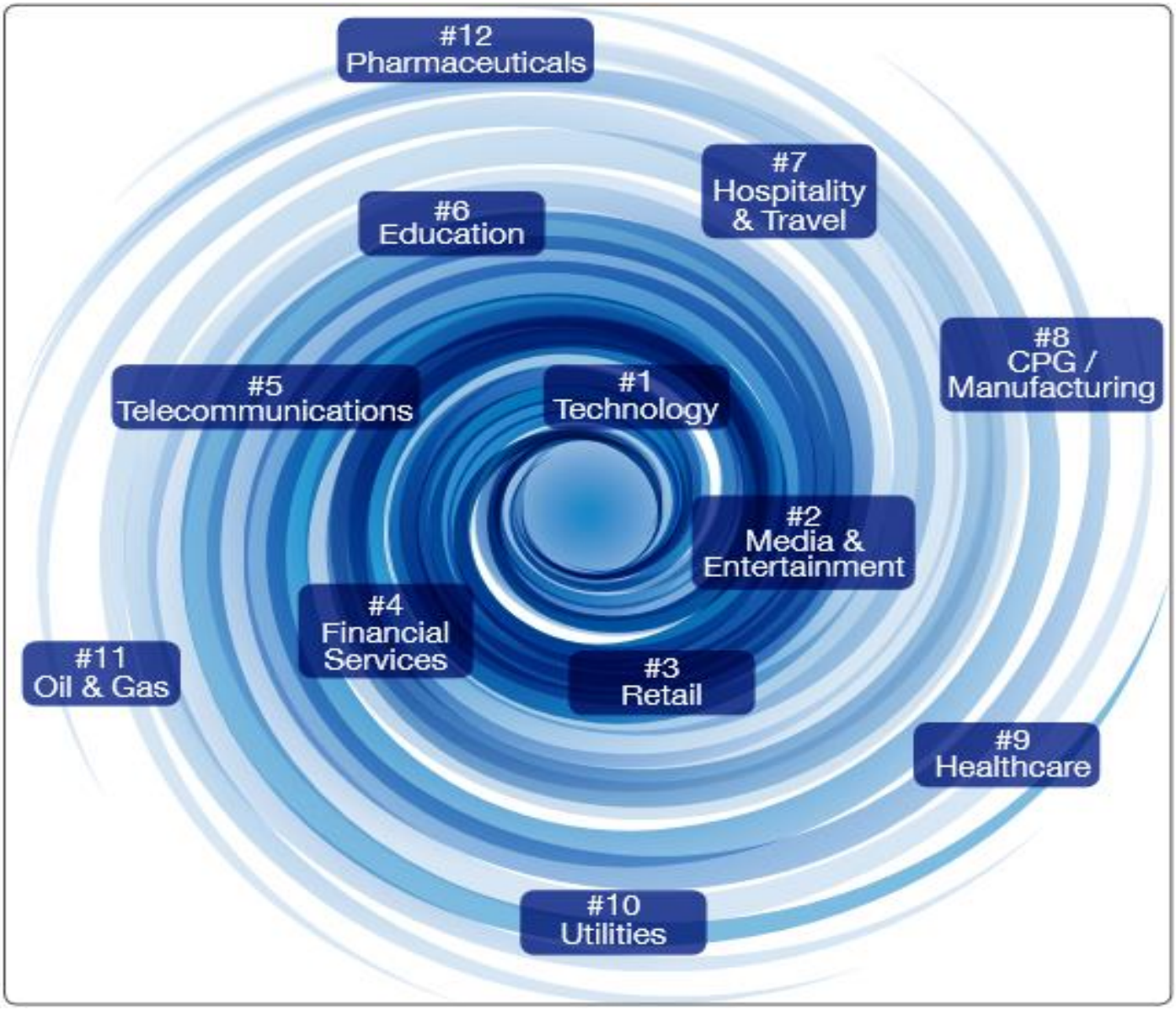
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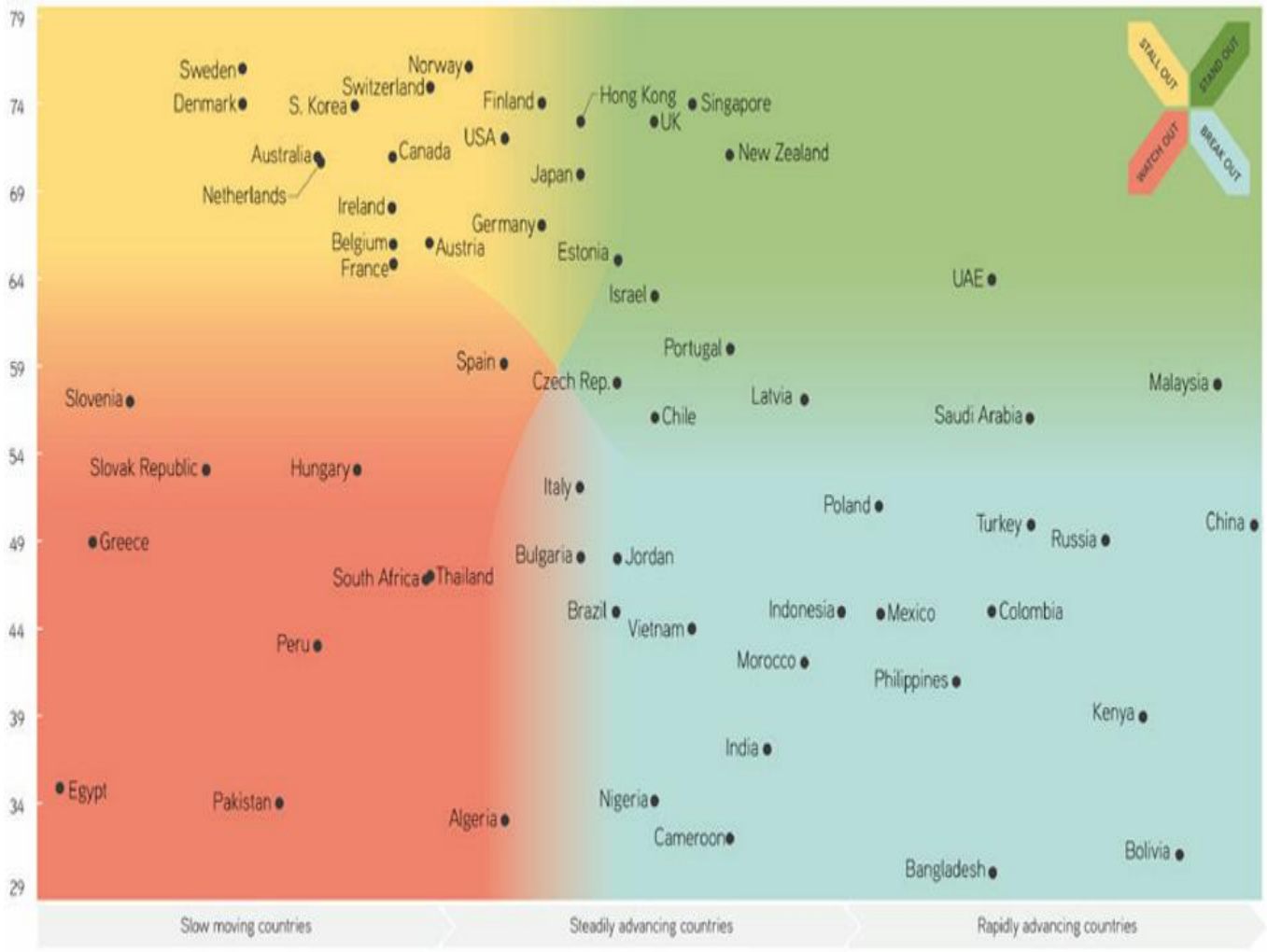
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Appendix A: The Digital Vortex



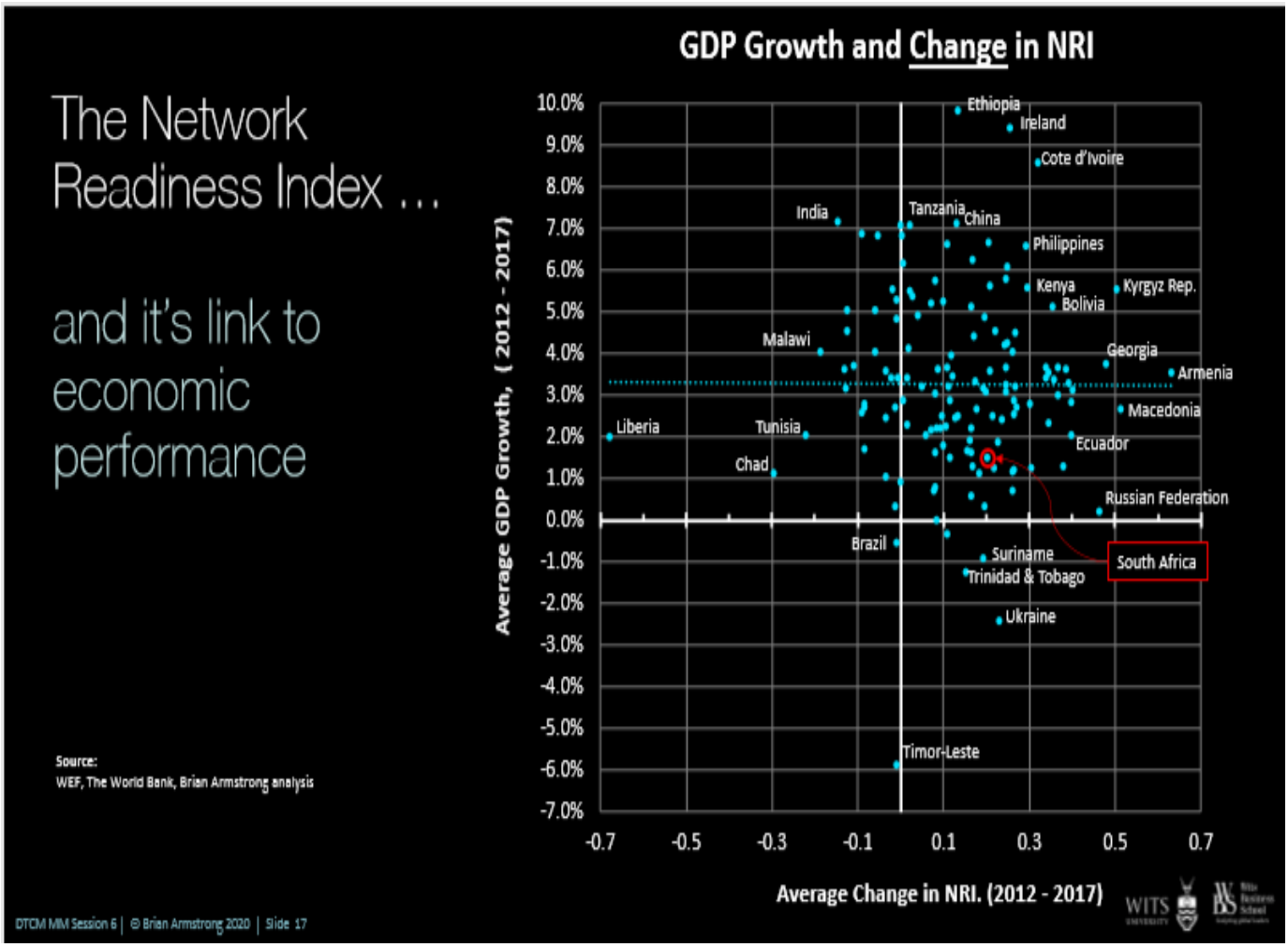
Source: Bradley et al. (2015)

Appendix B: Digital Evolution Index



Source: Chakravorti and Chaturvedi (2017)

Appendix C: GDP Growth and Change in NRI



Source: Armstrong (2020). DTCM Session 6: Slide 17

Appendix D: Model Variables and Data Sources

MODEL VARIABLES AND DATA SOURCES					
REGRESSION MODEL STRUCTURE	Category	Variable	Sub-Variable	Proxy Sub-Variable	Data Source
Financial Performance	Dependent Variable	Equity Returns	None		Bloomberg Database
	Dependent Robustness Test Variable	Return on Equity	None		Bloomberg Database
Digital Readiness Index Score (A+B+C)/3	Independent Variable(A)	Infrustructure (A+B+C)/3	Electricity Production(A)	Access to Electricity	World Bank Database
			Mobile Network Coverage(B)	Mobile Network Coverage,% Population	World Bank Database
			Internet Bandwidth(C)	Percentage of the population using the Internet	International Telecommunication Union
	Independent Variable(B)	Affordability (A+B+C)/3	Prepaid Cellular Tariffs(A)	Mobile-cellular subscriptions per 100 inhabitants	International Telecommunication Union
			Bradband Internet Tariffs(B)	Active mobile-broadband subscriptions per 100 in	International Telecommunication Union
			Telecoms Sector Concentration(C)		Bloomberg Database
	Independent Variable(C)	Skills (A+B+C)/3	Quality of Education(A)	Education Index	United Nation's Human Development Programme
			Adult Literacy Rate(B)	Labor force with advanced education (% of total la	World Bank Database
			Quality of STEM subjects(C)	Percentage of STEM graduates /Chinese STEM grad	UNESCO
Macro-economic factors	Control Variables	Macro-economic factors	GDP		World Bank Database
			Interest Rates		World Bank Database
			Exchange Rates		World Bank Database
			Unemployment		World Bank Database
			Inflation Rates		World Bank Database

Source: Author's Compilation

Appendix E: Panel Unit Testing Using ADF - Fisher Chi-square

Country	Variable	Banks		Insurance		Investments		Real Estate	
		Statistic	p-value	Statistic	p-value	Statistic	p-value	Statistic	p-value
Brazil	d(Equity Returns)-2	86.2989	0.0000	37.3352	0.0007	109.111	0.0000	145.503	0.0000
	d(Digital Readiness)-2	69.5384	0.0003	69.5384	0.0003	69.5384	0.0003	69.5384	0.0003
Russia	d(Equity Returns)-2	208.038	0.0000	9.84248	0.0073	75.8198	0.0000	83.5078	0.0000
	d(Digital Readiness)-2	338.979	0.0000	338.979	0.0000	338.979	0.0000	338.979	0.0000
India	d(Equity Returns)-2	311.354	0.0000	79.0034	0.0000	4073.40	0.0000	1090.13	0.0000
	d(Digital Readiness)-2	236.930	0.0000	236.930	0.0000	236.930	0.0000	236.930	0.0000
China	d(Equity Returns)-2	251.472	0.0000	46.7028	0.0000	404.654	0.0000	910.371	0.0000
	d(Digital Readiness)-2	223.939	0.0000	223.939	0.0000	223.939	0.0000	223.939	0.0000
South Africa	d(Equity Returns)-2	56.9908	0.0000	64.1055	0.0000	163.536	0.0000	165.404	0.0000
	d(Digital Readiness)-2	76.8964	0.0000	76.8964	0.0000	76.8964	0.0000	76.8964	0.0000

Source: Author's Calculations
Note: d (Digital Readiness)-2 is the second difference of Digital Readiness regressor variable, d (Equity Returns)-2 is the second difference of Equity Returns dependent variable

Appendix F: Lag Order Selection by Information Criteria

Country	Lag	Banks			Insurance			Investments			Real Estate		
		AIC	SC	HQ	AIC	SC	HQ	AIC	SC	HQ	AIC	SC	HQ
Brazil	0	28.33730	28.38034	28.35479	25.31224	25.38457	25.34028	25.57255	25.60565	25.58594	21.96142	21.99267	21.97404
	1	27.06191*	27.19103*	27.11438*	21.75750	21.97450*	21.84163*	24.55512*	24.65441*	24.59531*	17.97754	18.07130	18.01542
	2	27.07976	27.29496	27.16721	21.74974*	22.11141	21.88996	24.56878	24.73428	24.63576	17.71400*	17.87026*	17.77713*
Russia	0	25.17739	25.20208	25.18727	16.99535	17.06578*	17.02284	20.38057	20.43539	20.40269	37.80064	37.84566	37.81893
	1	24.47519	24.54927	24.50484	16.85885*	17.07013	16.94132*	19.80365*	19.96811*	19.87003*	37.49468	37.62974*	37.54955
	2	24.41108*	24.53453*	24.46048*	16.91402	17.26615	17.05148	19.82425	20.09836	19.93488	37.45456*	37.67966	37.54601*
India	0	27.91719	27.94322	27.92764	25.25547	25.32293	25.28204	23.95948	23.96246	23.96053	22.45413	22.46373	22.45777
	1	26.32306	26.40115*	26.35439	21.55469	21.75709*	21.63442	22.51058	22.51952	22.51374	21.19004	21.21884	21.20097
	2	26.27471*	26.40486	26.32692*	21.44497*	21.78230	21.57786*	22.41738*	22.43227*	22.42264*	21.11325*	21.16126*	21.13147*
China	0	31.20825	31.23901	31.22067	27.94033	28.01830	27.96979	26.96695	26.98612	26.97452	24.63986	24.65001	24.64372
	1	29.79402	29.88628*	29.83127	21.19305	21.42695	21.28144	26.02011	26.07763	26.04284	21.66002	21.69048	21.67162
	2	29.74886*	29.90262	29.81094*	20.72170*	21.11153*	20.86902*	25.96085*	26.05670*	25.99873*	21.56236*	21.61314*	21.58170*
South Africa	0	25.75136	25.82179	25.77886	22.85969	22.92716	22.88627	23.63950	23.67226	23.65276	21.98752	22.02050	22.00087
	1	23.08862*	23.29990*	23.17109*	18.82386	19.02625	18.90359	22.40252	22.50079*	22.44228	18.16451	18.26346	18.20456
	2	23.14499	23.49712	23.28245	18.44346*	18.78078*	18.57635*	22.35529*	22.51907	22.42156*	17.75340*	17.91831*	17.82014*

Source: Author's Calculations
*Note: * indicates lag order selected by the criterion, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.*

Appendix G: Model Robustness Per Industry

BRICS BANKING INDUSTRY ANALYSIS											
COUNTRY DEPENDENT VARIABLES	VARIABLE:	BRAZIL		RUSSIA		INDIA		CHINA		SOUTH AFRICA	
		Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE
	C	11206.650*** (5.534) [0.000]	8.415** (2.991) [0.003]	2286.336*** (5.282) [0.000]	-3.222 (-0.951) [0.342]	5581.194*** (12.096) [0.000]	5.111*** (4.376) [0.000]	21412.850*** (8.550) [0.000]	14.443*** (38.184) [0.000]	11415.980*** (11.753) [0.000]	15.998*** (21.089) [0.000]
EXPLANATORY VARIABLE	Digital Readiness	-3816.506 (-0.815) [0.4167]	-8.201 (-1.118) [0.265]	1410.507^ (1.572) [0.117]	-18.082* (-1.793) [0.074]	4259.025** (2.805) [0.005]	-12.520** (-3.327) [0.001]	-428.502 (-0.258) [0.796]	0.661* (2.494) [0.013]	879.564 (0.856) [0.396]	-0.961 (-1.271) [0.210]
MODEL STATISTICS	Adjusted R-Squared	0.471362	-1.593	0.368	0.130	0.480	-1.042	0.451	0.253	0.465	0.365
	Durbin-Watson Stat	1.969	2.451	1.415	1.918	1.848	2.767	0.782	0.943	2.141	2.480
	Hausman Test	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]
	Obs	135	135	300	300	279	279	221	221	59	59

BRICS INSURANCE INDUSTRY ANALYSIS											
COUNTRY DEPENDENT VARIABLES	VARIABLE:	BRAZIL		RUSSIA		INDIA		CHINA		SOUTH AFRICA	
		Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE
	C	3578.744*** (7.417) [0.000]	30.297*** (5.953) [0.000]	38.752* (2.264) [0.028]	14.006*** (3.718) [0.000]	4094.912*** (4.356) [0.000]	13.197*** (5.137) [0.000]	11748.72*** (12.461) [0.000]	6.447*** (4.827) [0.000]	1832.879*** (10.702) [0.000]	26.803*** (5.011) [0.000]
EXPLANATORY VARIABLE	Digital Readiness	2.216 (0.005) [0.995]	0.183 (0.041) [0.967]	-18.493 (-0.954) [0.345]	15.504** (3.282) [0.002]	-4611.223^ (-1.319) [0.193]	4.632 (0.485) [0.629]	1483.225 (0.824) [0.415]	-0.385 (-0.151) [0.880]	-74.856 (-0.554) [0.581]	-3.951 (-0.937) [0.353]
MODEL STATISTICS	Adjusted R-Squared	0.734	0.260	0.035	-0.141	-1.224	0.289	0.898	0.374	0.914	-0.033
	Durbin-Watson Stat	1.751	1.582	1.710	1.831	3.080	1.235	2.498	1.704	1.763	2.390
	Hausman Test	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[0.000]	[0.000]	[1.000]	[1.000]
	Obs	56	56	59	59	64	64	48	48	64	64

COUNTRY DEPENDENT VARIABLES	BRICS INVESTMENTS INDUSTRY ANALYSIS										
	VARIABLE:	BRAZIL		RUSSIA		INDIA		CHINA		SOUTH AFRICA	
		Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE
	C	2014.881*** (5.170) [0.000]	-19.580** (-2.862) [0.004]	328.492** (3.350) [0.001]	4.144*** (3.557) [0.000]	169.037*** (7.279) [0.000]	2.139*** (10.470) [0.000]	4230.518** (3.094) [0.002]	5.383*** (4.496) [0.000]	868.170*** (7.188) [0.000]	9.681*** (6.424) [0.000]
EXPLANATORY VARIABLE	Digital Readiness	-199.472 (-0.224) [0.822]	-0.540 (-0.044) [0.964]	409.819* (1.799) [0.076]	-1.405 (2.493) [0.574]	877.868** (2.702) [0.006]	-3.247 (-1.181) [0.237]	10553.080^ (1.327) [0.185]	6.441 (0.886) [0.375]	-222.952 (-1.170) [0.243]	2.902^ (1.439) [0.151]
MODEL STATISTICS	Adjusted R-Squared	0.539	0.572	-0.255	0.015	-0.112	0.299	-17.910	-0.415	0.363	0.393
	Durbin-Watson Stat	1.545	1.540	1.482	1.385	1.692	1.234	2.441	1.952	0.933	1.849
	Hausman Test	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]
	Obs	199	199	92	92	4272	4272	422	422	202	202

COUNTRY DEPENDENT VARIABLES	BRICS REAL ESTATE INDUSTRY ANALYSIS										
	VARIABLE:	BRAZIL		RUSSIA		INDIA		CHINA		SOUTH AFRICA	
		Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE	Equity Returns	ROE
	C	938.262*** (24.202) [0.000]	-28.586*** (-7.230) [0.000]	1994908.000*** (4.685) [0.000]	-20333.430 (-0.747) [0.456]	155.462*** (9.379) [0.000]	2.676** (3.067) [0.002]	1752.037*** (29.327) [0.000]	8.527*** (16.567) [0.000]	1067.579*** (13.210) [0.000]	19.157*** (4.957) [0.000]
EXPLANATORY VARIABLE	Digital Readiness	337.720*** (10.048) [0.000]	10.288** (3.001) [0.003]	1106903.000 (0.141) [0.887]	-145160.200 (-0.334) [0.738]	115.433 (0.687) [0.492]	-9.621^ (-1.306) [0.191]	-138.647*** (-4.666) [0.000]	-0.125 (-0.505) [0.613]	-105.888* (-1.662) [0.098]	-2.929 (-0.961) [0.337]
MODEL STATISTICS	Adjusted R-Squared	0.838	0.766	0.312	0.238	0.429	0.009	0.654	0.213	0.873	-0.297
	Durbin-Watson Stat	1.127	1.596	1.639	1.703	1.168	1.721	1.754	1.299	1.588	1.598
	Hausman Test	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]
	Obs	216	216	126	126	1028	1028	958	958	200	200

Source: Author's Calculations